MANUAL OF THE DOMESTIC HYGIENE OF THE CHILD

FOR THE USE OF STUDENTS, PHYSICIANS, SANITARY OFFICIALS, TEACHERS, AND MOTHERS

BY

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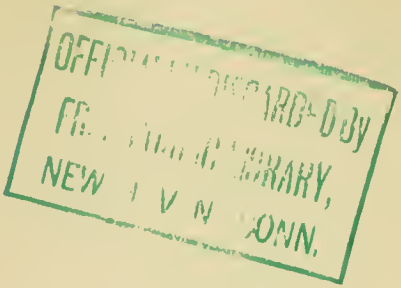

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EDITOR'S PREFACE.

The German original from which this treatise on the Personal Hygiene of Childhood has been translated, is addressed to "Students, Physicians, Sanitary Officials, and Pedagogues." The translation, made by an American mother, addresses itself to intelligent mothers among the readers who may interest themselves in its pages. The treatise it is true does contain a great many "technical" details. It does so because these are essential to accurate information; and it is the intention of the book to convey useful and interesting information, and not merely to repeat commonplaces or vapid generalizations. But the non-professional reader need not be alarmed by the appearance of technicality. All statements are so explained as to be perfectly intelligible when read with reasonable attention. The editor has, moreover, inserted such additional remarks or paragraphs as seemed desirable in order to render the main text more clear or distinct, or to supply an occasional detail with which the non-professional reader might be supposed to be unacquainted. Such editorial additions have been included between brackets, so as to leave intact the responsibility of the author.

In order to further facilitate the use of the book by non-professional mothers, the greater part of the tables and analyses which the author retained in the text, have, by the editor, been transferred to foot-notes. These may be left aside by the non-professional reader without interfering

with the continuity of the text; while yet an abundance of scientific data are placed at the disposal of the physician and medical student. In this way it is believed that the treatise has been preserved in all its value for the professional classes for whom it was originally designed; and yet, without emasculation, has been placed entirely within the reach of intelligent non-professional women.

From the increasing number of women who before marriage have received the intellectual training of a college education, it is to be expected that there would be recruited a constantly increasing number of mothers who are seriously interested in understanding the problems involved in the physical care of their children. Such educated women will desire to have an educated view of the principles upon which they must rely in this great work of rearing their offspring: they will refuse to be satisfied with mere collections of precepts, suited for uneducated persons. It is for such women that these pages are intended.

M. Putnam Jacobi.

New York, 1890.

INTRODUCTION.

The following text-book on "Private or Domestic Hygiene of Children" is the most important part of Professor Uffelmann's elaborate treatise, "Handbuch der privaten und öffentlichen Hygiene des Kindes."

"Manuals of Nursing" and "Hints to Mothers" are by no means lacking, and doubtless have a large field of usefulness; but there does not exist another work on the hygiene of children which devotes to the period of girlhood and boyhood the same careful attention that it gives to infancy and early childhood. Older children are too often treated as though they had no physiological characteristics peculiar to their years and entitled to special consideration.

Detailed discussion of the various cereal and other manufactured foods for children, together with statistics regarding results of their use, can nowhere else be found.

On the anthropometry of infants and children, and the normal physical standards from which to estimate a child's structural development, Professor Uffelmann's work is both succinct and complete. His rules are clear and valuable.

The author has freely availed himself of American reports and statistics, with a liberality so rarely shown by European writers that it calls for grateful acknowledgment.

The book repeatedly points out gaps yet to be filled by systematic research in the field which it so largely covers. Thus it incites students to original work, and teaches them where they may investigate with best prospects of valuable returns.

A practitioner and teacher of international repute, Professor Uffelmann has presented to the laity and to the medical profession a volume more complete than any one of its kind previously published. A work of this character, grounded on physiology and statistics from all countries, belongs to the indispensable literature of the subject. Translation has now made it accessible both to the Italian people and to the English-speaking nations. To many a mother and to many a conscientious teacher or guardian, the volume will prove a scientific substitute for well-meant but ill-advised suggestions of aunts, grandmothers, and old nurses with regard to the care of children. It treats of topics which are of vast importance and but meagrely understood, and concerning which the advice given by those least competent to counsel is most often followed.

Roswell Park.

The University of Buffalo,
Buffalo, N. Y., September 2, 1889.

AUTHOR'S PREFACE.

The hygiene of the child is the art which aims to preserve and promote to the utmost its physical and mental health. It should therefore endeavor to secure the most perfect development possible for the growing organism; should indicate the dangers by which this may be menaced, and teach the methods by which these may best be avoided. The great practical importance of such an art is obvious. Children are the pride and happiness of the family. The most passionate desire of parents is that their children may develop into strong and healthy adults; the keenest enjoyment the world offers to parents, is that of watching the process of such development. With the children rests the entire future of the state, whose greatness and power, whose defence and prosperity are secure, only when its citizens are vigorous in mind and body. It is in childhood that must be laid the foundations of the strength and vigor of manhood. The entire constitution of the adult—his power of resistance, his capacity for work—depends first of all upon his childhood, and upon the care he may have received during the formative period of his existence. From lack of such care many an unhappy human being has suffered throughout life, and even transmitted to succeeding generations evils acquired during childhood, or which, with better care, might have been eradicated.

The importance of infantile hygiene is not lessened but rather enhanced by its difficulty. It is during childhood

that the human organism is exposed to its most serious dangers[1]; while its helplessness renders it absolutely dependent upon the skill, attention, and foresight of those to whose care it is committed.

The hygiene of the child is Personal or Public. The former, which is alone considered in this volume,[2] treats of the care of the individual child brought up in the family, and pays especial attention to individual peculiarities. Public hygiene is guided by the same principles, but considers classes of children together, grouped according to various social exigencies: thus the children of the poor—children consigned to the care of strangers, children employed in factories and workshops. This collective hygiene, or hygiene of classes, necessitates certain general regulations which need not be considered in relation to an individual child.

The hygiene of the child has a history as old as that of medicine itself. It requires the co-operation of auxiliary sciences—statistics, physiology, the etiology of disease. Finally, it derives much from general hygiene, yet nevertheless is necessarily as distinct from the latter as is the pathology of the child from that of the adult.

J. U.

[1] This remark is especially true of the period below the age of ten. Between the ages of ten and fifteen the expectation of life is higher than at almost any other time. —EDITOR'S NOTE.

[2] Uffelmann's original treatise contains the following subjects: "History of the Hygiene of the Child," "Conditions of Birth and Mortality," "Morbid Liabilities of Childhood," "Etiology of the Principal Diseases," "Private Hygiene," "Public Hygiene."

THE PERSONAL HYGIENE OF THE CHILD.

CHAPTER I.

EXAMINATION OF THE CHILD.

The personal hygiene of the child treats of the care of a human being from birth to puberty.[1]

During this period of fourteen to fifteen years the human organism presents many physiological peculiarities. As compared with the adult, the child has less strength and stability, less power of endurance, but a greater soundness of organs. Disturbance of the healthy equilibrium is frequent, and occasioned by slight causes; but the balance is as readily restored. The molecular changes in the tissues are rapid, the nervous system excitable and easily fatigued; the entire organism is peculiarly plastic, flexile, adaptable. The absence of the sexual functions alone would be sufficient to establish a wide difference between the physiology of the child and that of the adult. The younger the child, the more conspicuous are its peculiarities; these retreat into the background as puberty approaches. Born in a perfectly helpless condition, the child gradually develops to strength and independence, and during the process of development the organs which sustain its individual existence are undergoing

[1] In strict accuracy, the care of the child before birth should also be considered. But as this can only be effected through care of the mother, this branch of the subject is discussed with the "Dietetics of Pregnancy."

constant changes. These changes, minute from day to day, but incessant throughout the whole period of growth, demand a watchfulness as incessant and as minute. The period of growth may be divided into several stages. There is:

1st. The nursing stage, from birth to the moment of weaning, comprising therefore about the first year of life.

2d. The stage of childhood proper, from the first to the beginning of the seventh year—that is, to the second dentition.

3d. The stage of boyhood or girlhood, covering the next seven years—that is, from the beginning of the second dentition to puberty or adolescence. The foregoing division corresponds to important differences in the degree of evolution reached by the developing organism, whose physiology is therefore necessarily different in the different stages of growth. And experience has shown that the morbid susceptibilities, or liabilities to disease, also varies. Some diseases are absolutely limited to the first days or weeks of life; and others, though possible through all periods of childhood, greatly preponderate at the one or the other.

[There are therefore two ways in which the hygiene of the child could be studied. Each of the three great periods of childhood could be considered separately in regard to the details of food, clothing, housing, and care of special organs and functions, as the requirement varies with the age. Or, each of the foregoing subjects could be discussed apart, with all the modifications required at the different periods of the child's life. It is the latter method which has been adopted.] Before entering upon the consideration of the first subject—the nourishment of the child—I wish to draw attention to some important data to be obtained by the detailed examination of the child.

WEIGHT.

A healthy child, which has been born at full term, weighs at birth, on an average, 3,000–3,500 grammes (6½ to

7 pounds). The lower average weight is for girls, the higher for boys.

At puberty the child should have increased to about twelve times its original weight, so that at the age of fifteen it should weigh 36,000–42,000 grammes (78 to 84 pounds).

The rate of increase in weight is never uniform, and at certain periods is extremely irregular. [Now it is highly important to become familiar with the normal rate and normal irregularities, for abnormal irregularities in weight are most valuable indications of malnutrition; indications, moreover, which are easily ascertained. A good balance should be part of the furniture of every well-appointed nursery.] [Although the primal destiny of the child is to grow, the new-born babe does not begin by gaining, but by actually losing, weight.] In the first three or four days after birth the loss amounts to $\frac{1}{12}$–$\frac{1}{15}$ of the original weight, that is, from 200 to 300 grammes (7 to 10 ounces). [This loss is not, however, sustained by the organs of the child's body], but depends largely upon the discharge of its excretions. [Urine indeed has been discharged into the amniotic sac during fœtal life, and constitutes a part of the amniotic liquor, or the "waters," whose pressure helps to protect the fœtal head during the process of parturition.] But the fæces or meconium are not discharged, but accumulate in the intestine until after birth, when, by their evacuation, as has been said, the weight of the body is diminished.

A second reason for this diminution is the imperfect assimilation of food, either by the digestive organs or by the tissues after it may have passed into the circulation. On this account the wear of tissues [which begins with the oxidations initiated by respiration] is not sufficiently compensated, and loss of weight again results. Some authors, as Ritter, insist, however, that this initial loss of weight is not normal, but always indicates defective nutrition. It seems that they have observed individual cases in which no

loss was sustained. But I have observed it almost universally, and among children situated in the most favorable conditions. And the physiological nature of the phenomenon is claimed to have been demonstrated by many high authorities, and after the most careful and multiplied weighings.[1]

[It is interesting to notice that] the period of loss, normally only three or four days, lasts longer with children artificially nourished than with those fed at the breast; and among the latter, longer when the nurse is a primipara[2] (Haake, Kazmarsky). [This fact shows that under the latter circumstances the assimilation of food is less easily effected.] On the third or fourth day the turning-point is reached, and from that time the baby begins to gain. The original weight is recovered on the seventh to tenth day. At the end of the first month the baby should weigh a third more than it did at birth, thus 4,000 to 4,700 grammes ($8\frac{3}{4}$ to $10\frac{1}{3}$ pounds).

In the middle of the third month the original weight should be doubled (13 to 14 pounds); at the end of a year it should be tripled ($19\frac{1}{2}$ to 21 pounds).

The daily average gain varies from month to month, regularly lessening after the first, as is shown by the tables in the note.[3]

[1] Winckel, Fleischmann, Breslau, Gregory, Haake, Quetelet.

[2] *I.e.*, has had but one child.—ED.

[3] Table I., from Fleischmann: Ueber Ernährung und Körper Wägungen der Neugebornen und Säuglinge.

	grms.
Daily gain in 1st month . .	= 35.00
" " 2d " . .	= 30.00
" " 3d " . .	= 28.00
" " 4th " . .	= 22.00
" " 5th " .	= 18.00
" " 6th " . .	= 14.00
" " 7th " .	= 12.00
" " 8th " . .	= 10.00
" " 9th " . .	= 10.00
" " 10th " . .	= 9.00
" " 11th " . .	= 8.00
" " 12th " . .	= 6.00

Table II., from Gerhardt: "Lehrbuch der Kinderkrankheiten," 1881, p. 2. (A gramme = $15\frac{1}{2}$ grains.)

	grms.
Daily gain in 1st month . .	= 25.00
" " 2d " . .	= 23.00
" " 3d " . .	= 22.00
" " 4th " . .	= 20.00
" " 5th " . .	= 18.00
" " 6th " . .	= 17.00
" " 7th " . .	= 15.00
" " 8th " . .	= 13.00
" " 9th " . .	= 12.00
" " 10th " . .	= 10.00
" " 11th " . .	= 8.00
" " 12th " . .	= 6.00

This progressive increase in weight [even if maintained steadily during lactation] is often disturbed during weaning. Either the gain remains below the normal standard, or the increase is altogether arrested, or there may be a loss. Similar perturbations are occasioned by teething. Apart from these physiological conditions, a loss of weight during the first year always indicates malnutrition, or even specific illness.

During the second year of life, the child adds one fifth to the weight gained by the end of the first year.

During the third year the gain is only one tenth.

From the fourth to the eighth year in girls, and in boys until the tenth year is finished, there is an average annual gain of 1,500 to 1,800 grammes ($3\frac{1}{3}$ to 4 pounds). Then, from the ninth and eleventh years respectively, there is a steady annual gain until puberty.[1]

Increase in weight is not alone to be taken into account in estimating the nutrition of the growing organism. It

[1] The following table by Quetelet measures the growth of a boy from his 1st to his 15th year:

		Absolute increase.
Initial weight	= 3,200 grms. (7 lbs.)	
1st year	= 9,450 " ($20\frac{3}{4}$ lbs.)	6,250 grms.
2d "	= 11,340 grms. (25 lbs.)	1,890 "
3d "	= 12,340 " (27 lbs.)	1,130 "
4th "	= 14,230 " (31 lbs.)	1,740 "
5th "	= 15,770 " ($34\frac{3}{4}$ lbs.)	1,540 "
6th "	= 17,240 " (38 lbs.)	1,470 "
7th "	= 19,100 " (42 lbs.)	1,860 "
8th "	= 20,760 " (45 lbs.)	1,660 "
9th "	= 22,650 " (50 lbs.)	1,890 "
10th "	= 24,520 " (54 lbs.)	1,870 "
11th "	= 27,100 " (59 lbs.)	2,580 "
12th "	= 29,820 " (65 lbs.)	2,720 "
13th "	= 34,380 " (75 lbs.)	4,560 "
14th "	= 38,670 " (85 lbs.)	4,290 "
15th "	= 43,620 " (96 lbs.)	4,950 "

must be carefully compared with the increase in the length of the body, with which it should keep parallel.

LENGTH.

The average length of a new-born child is 50 centimetres (20 inches), or somewhat less than one third the average length of an adult. The full height, or eleven twelfths of it, is attained during the beginning of the fifteenth year.

The most rapid relative growth takes place during the first year. At the end of this the child has, on an average, gained 20 cm. in height, or 40 per cent. It measures therefore 70 cm. (28 inches). The lower half of the body grows a little faster than the upper half. In a new-born child, fully developed, the distance from the crown of the head to the crest of the hip-bone is exactly the same as the distance from the latter point to the sole of the foot. But in a year-old child this second distance is greater than the former. The original relation of the two measurements to each other is as 500 : 500. It is now as 478 : 522 (Zeising).[1]

In the second year of life the length of the child increases 10 cm. (4 inches), nearly 15 per cent. In the third year the increase is 7 cm., or 8 per cent. From the beginning of the fourth year the growth remains fairly regular, about 5 cm. (2 inches) annually. With the beginning of the fifteenth year is reached the average height of 150 cm. (5 feet). This is true for boys. Girls are usually shorter, but relatively to the maximum to be attained, their height is in advance of that of boys.[2]

[1] Ueber die Metamorphosen in den Verhältnissen der menschlichen Gestalt von der Geburt bis zur Vollendung des Wachsthums.—Verh. der Lesp,-Carol. Akad., 1858, vol. 26.

[2] If a girl measure at birth 49 cm. (19,6 inches).
She measures at the end of the 1st year 69 " (25.6 ").
" " " " " " " 3d " 86 " (34.4 ").
" " " " " " " 10th " 126 " (50.4 ").
" " " " " " " 14th " 147.5 " (59. ").

There are individual differences, but still a considerable variation from these figures indicates abnormal development. The defect may lie on the side of an excess of growth as well as of a deficiency, and the excessive height is especially abnormal if unaccompanied by proportionate increase in breadth.

An excellent rule for estimating the correct proportion between height and breadth is the following:

At all periods of growth the measure across the shoulders should be about one fourth the length of the entire body.[1]

[An important difference between boys and girls is early disclosed in the shoulder measurements.] In boys the breadth of the shoulders is the same as the breadth of the hips. [In girls it is less.] This sexual difference appears at birth, but becomes more marked in the later periods of childhood. The breadth of the shoulders does not increase in precisely the same proportion as does the length of the body. The latter, in fourteen years, grows to three times the initial length, the former to 2.65 times the initial breadth.

Another important comparison is that between the *circumference of the chest* (measured at the level of the nipples) and the length of the body.

The chest circumference of the new-born infant is 9 to 10 cm. (3.6 to 4 inches) in excess of half the length; thus should be 34 or 35 cm. (13.6 to 14 inches). If the chest circumference exceeds this proportion it is a favorable sign, [indicating a probably vigorous development of the fundamental nutritive organs—the heart and lungs]. Should the difference between the chest circumference and the semi-length of the body (25 cm., or 10 inches) be less

[1] Diameter across shoulders at birth, 13.7 cm. (5.4 inches). Total length, 50 cm.
" " " " 3d year, 23. " (9.2 "). " " 87 "
" " " " 6th " 32. " (12.8 "). " " 122 "
" " " " 14th " 36. " (14.4 "). " " 150 "

than 8 cm., decided bodily weakness must be inferred (Frobelius).[1]

The initial proportion between the chest circumference and the semi-body length does not persist unchanged. The difference increases until the fifth year [owing to the development of the lungs during the first exercise of the respiratory functions]. Thus: after the third year, chest circumference exceeds semi-length of body by 12 cm.; should therefore average 55½ cm. (2.2 inches). After the fifth year the excess falls again to 10 cm.; circumference should then measure 10 cm. more than half of their normal height, or 58½ cm. (23.4 inches). [From this time the body grows steadily in height, while the lungs, accustomed to their extra-uterine functions, grow until puberty only in proportion to the other organs of the body.] After the tenth year, therefore, the difference between the chest circumference and the semi-length of the body falls to 4 to 5 cm. (2 inches), and in the fourteenth or fifteenth year the two measurements should be the same. [At this age the thorax, with its contained viscera, the heart and lungs, takes on an especially active development, but this remains, normally, exactly correlated with the rapid increase of weight characteristic of adolescence.]

[Comparison of the circumference of the chest with that of the body length enables us to detect when the chest is too small. Comparison of the circumference of the chest with that of the head detects more especially when the head is too large, as it is in children affected by rickets.][2]

The following is the rule: *In the new-born child the circumference of the chest measures 3 to 4 centimetres (1.2 to 1.6 inches) less than that of the head.* [From birth on as the

[1] Imperfect development of the chest is especially to be looked for in the children born in consumptive families. But the characteristic shape of the phthisical chest becomes especially marked at puberty.—Ed.

[2] Compare Liharzik, "Das Gesetz des menschlichen Wachsthums," 1858.

growth of the brain slackens, that of the heart and lungs increases], *and by the third year the periphery of the chest and head equal each other.* Later, the chest considerably exceeds the head in circumference.

GREAT FONTANELLE.

The great or anterior fontanelle affords an index for infantile development. During the first months, while the brain is still growing rapidly, the fontanelle widens somewhat [thus securing more space within the cranium than would be afforded only by the growth of its bones]. It is widest at eight or nine months. In healthy children, [in whom the ossification of the skull is proceeding at a normal rate], the fontanelle begins to diminish in size from the tenth month, and is quite closed at the sixteenth. Earlier or later closure each indicates a serious defect in nutrition. [Too early closure interferes with the expansion of the brain, which remains arrested in its development, sometimes at such an imperfect stage as to be incompatible with intelligence. The child is then a microcephalic idiot. Sometimes the premature closure of the fontanelle and ossification of the skull must be regarded as the consequence of a spontaneous arrest of the development of the brain. In either case, the nutritive force and material which are normally absorbed by nervous tissue, is diverted to the less highly organized osseous tissue of the skull.[1]

Delayed ossification of the cranial bones, with corresponding delay in the closure of the fontanelle, indicates an opposite nutritive defect, and one much more frequently encountered. The child is affected more or less profoundly with rickets, the constitutional vice of nutrition in which all the tissues of the body are imperfectly nourished during

[1] Premature ossification of the articulations connecting the bones at the base of the skull, causing arrested development of the basilar process, and hence diminishing the area of the cranial base, is the fundamental condition of the cretin head.—Ed.

growth, hence imperfectly elaborated or developed. The defect is particularly conspicuous in the bones, which remain soft much longer than is normal. Therefore the expanding brain is able to press out the bones of the cranium laterally, in the same way that the weight of the body, pressing on the bones of the legs, tends to bend them from a straight line. Thus the children who have abnormally large heads, spreading on the sides, flattened on top and behind, and with the fontanelle open after the sixteenth month, are likely also to have bow-legs; and, further, the yielding cranial bones permit too much growth to the nervous tissue of the brain, a circumstance which often renders the child intellectually active and precocious. But as the blood-vessels of the brain do not grow in like proportion, it is liable to remain throughout life anæmic relatively to its mass, and ill-nourished.] The nutritive defects which [result in such grave consequences], require therefore to be most energetically combated.

THE TEETH.

The first teeth usually appear between the sixteenth and the twenty-second week. The two lower middle incisors normally come first; then, after a pause of four to eight weeks, the four upper incisors come through one after another. The lower external incisors do not show themselves until the beginning of the second year, and are followed by the first four double teeth (the bicuspids). In the second half of the second year the eye-teeth or canines are cut; and finally, in the beginning of the third year, the four molars, which complete the twenty milk-teeth of the first dentition.

The second dentition begins with the sixth year. The twenty milk teeth lose the arteries and nerves of their roots by the pressure of the second row of teeth [imbedded beneath them in the gum, and which begin to grow upwards

as the tissue in front is gradually atrophied and absorbed].[1] Thus the milk-teeth, one after another, deprived of their nutritive roots, become loosened and dislodged, and this occurs for the most part in the same order as their successive appearance. Twenty new teeth replace those which have fallen, and, in addition, four more double teeth—the permanent molars. In the eleventh and twelfth year four more molars appear, making twenty-eight teeth in all. The last teeth, the so-called wisdom teeth, do not belong to the period of childhood, but are cut between the twentieth and twenty-fifth year.

Defective nutrition is indicated by the late appearance of the milk-teeth—thus, not till the second year—by their premature loss, and by the imperfect formation of either these or the permanent teeth. [Rickets, which, as has been already mentioned, is indicated by peculiarities of the head or bones of the legs, is the nutritive disorder most commonly associated with defective teeth. But sometimes certain specific diseases may be diagnosed from the same defect.]

Other signs of defective nutrition than those which have now been enumerated may be obtained by the careful examination of other organs. But these signs will be mentioned in their appropriate place.

EPOCHS REQUIRING SPECIAL CARE.

1st. The first weeks of life, on account of the great susceptibility to injury of the new-born child, and also of its special liability to certain serious diseases (tetanus, ophthalmia, erysipelas, etc.).

2d. The first dentition, which, though not directly producing, nevertheless predisposes to illnesses.

[1] Thus the expression, "the teeth *cut* the gums," is quite incorrect. The eruption of teeth is a process which bears much resemblance to the development and successive progress of the Graafian vesicles from the depth to the surface of the ovary.—Ed.

3d. The weaning period, when severe digestive disturbances are so frequent.

4th. Hot weather at any age under two years, on account of the liability to intestinal catarrh.

5th. The period of school attendance, on account of the liability to contract infectious diseases.

6th. The period of transition to puberty, because of the important physiological changes then effected in both body and mind.

CHAPTER II.

NOURISHMENT OF THE CHILD.

SECTION I.—GENERAL CONSIDERATIONS.

An adult organism only requires to be maintained in *statu quo*, in material equilibrium. An increase of mass is unessential, although it may occur.

For a growing organism, more is needed. The equilibrium of the mass must be preserved, but in addition, its bulk must be steadily increased. For this reason alone it would be necessary to regulate the diet of a child upon a different plan from that of an adult. But, further, the digestive powers of a child differ considerably from those of a grown person; [the difference being greatest as we approach the first days after birth, when the digestive organs first enter upon their functions]. The amount of food utilized, after absorption, by the tissues of the child is different from that appropriated by the tissues of the adult; and the molecular changes in the tissues are also different in the two. The subject of tissue assimilation and molecular change demands some special consideration.

TISSUE-CHANGES IN THE CHILD.

These are characterized by much greater rapidity than is observed in the adult. This rapidity is believed to be due to the quicker circulation of the blood; to the greater vascularity of the tissues; to the greater amount of water entering into their composition; to the more delicate structure of the cells. Compared with the adult organism, the

growing organism consumes more non-nitrogenous material, and produces more carbonic acid. This has been demonstrated both for the human young and for mammalian animals.[1]

The nitrogenous or albuminous part of the food is not, like the non-nitrogenous, entirely decomposed and eliminated. All is indeed metamorphosed into other forms of albumen, but under these forms, a considerable part of the albumen is retained in the system.

The disassimilation and excretion of albumen is measured by examination of the excretion of the urea which is derived from it, [and which is contained in the urine].

In the first weeks of life, the quantity of urea excreted is small, but soon begins to increase. From the age of three to five years the excretion of urea for each kilo weight of the body is greater in the child than in the adult. Therefore, though the absolute amount excreted be less, the relative amount is greater in the child. [This implies that nitrogenous food is more rapidly decomposed and digested by the child, since the urea excreted results from the decomposition in the tissues of the nitrogenous food absorbed.[2]]

The calculations quoted in the note are based on examination of the urine alone. In order to estimate exactly the decomposition of albuminous substances, we must measure not only the nitrogen of the urea, but also that contained

[1] Soxhlet found that a suckling calf produced daily for each kilo (2 pounds) of its weight, 19.5 grammes of carbonic acid. The grown animal produced only 10.3 grammes. ("Bericht über die Arbeiten der k. k. landwirthsch. chem. Versuchstation," Wien, 1870–1877.) According to Andral and Gavarret, a boy, eight years old, produced 21.1 grammes carbonic acid for each kilo of his weight; an adult, 14.3 grammes. Quoted by Vierordt, in Gerhardt's "Handbuch der Kinderkrankheiten," vol. i., p. 135.

[2] The following comparative calculations have been made:

For 1 kilo of an adult,	0.55	urea daily.				
" 1 "	in child 5	months old,	0.50	urea daily	(Picaid).	
" 1 "	" 3–5	years,	1.017	" "	(Rummel).	
" 1 "	" 3½	"	0.699	" "	(Scherer).	
" 1 "	" 8	"	0.811	" "	"	
" 1 "	" 13	"	0.606	" "	(Uhle).	

in the fæces. This has been done by Camerer. From the result (see note [1]) we may assume for all children past the period of lactation a much more rapid transformation of albuminous substances than exists in the adult. The nursing child,[2] however, seems to decompose less albumen, and excrete less nitrogen, either in urea or otherwise, because the rapidly growing organs withdraw so much albumen from the circulation, and fix it in their tissues, in order to build these up. [These physiological facts are in accordance with the character of the food prepared for the infant by nature, namely, milk. This food is extremely rich in albumen, and an albumen moreover of an especially digestible kind,[3] and existing in a form most easily assimilable. From this standard the diet must only gradually deviate as the child advances in age.]

DIETARY OF THE CHILD.

In constructing the diet of the child, it is important to remember at the outset that it requires much *less variety* of food than do grown persons. No sweets or other delicacies are required to gratify the palate. The child at the breast receives the same food day after day, and only one

[1] Nitrogen in urine and fæces daily :

Child 3 months old, total = 0.73.	Per kilo = 0.13.	
" 6–7 " " " = 3.01.	" " = 0.44.	
" 3–4 years " " = 6.6.	" " = 0.50.	
" 5–6 " " " = 8.4.	" " = 0.46.	
" 11 " " " = 9-4.	" " = 0.40.	

Adult weighing 65 kilos total nitrogen = 18.3, and per kilo = 0.27. (*Zeitschrift fur Biol.*, xiv. and xvi., 1.)

[2] Soxhlet (*loc. cit.*) found that the suckling calf excreted less nitrogen in the urine and fæces than the grown animal. And Voit concludes that the *nursing* child decomposes less albumen than the adult, because the growing organs quickly appropriate the albumen circulating in the tissues (" the stream of circulating albumen "), and thus protect it from decomposition. (Physiol. des Stoffwechsels und der Ernährung. Hermann's " Handbuch der Phys.," 1881, vi., 1, p. 536.)

[3] The term " albumen " belongs properly to an entire group of nitrogenous organic substances, which vary from each other slightly in both chemical composition and physical characters.—ED.

sweet, sugar. Children of two or three years old thrive on a uniform fare of milk, bread, and meat,—and the pleasures of the table do not agree with them,—[indeed are unappreciated until much later in life].

The child requires the same nutritious substances as the adult; but it requires them in *comparatively larger quantities.* A different relation is needed between the nitrogenous and non-nitrogenous substances, because of the special requirements of the growing organs, which are constantly increasing their mass by means of the substances which they appropriate from the food, and especially of its albumen.

The muscles of the new-born infant weigh 625 grammes (1.38 lbs.). The muscles of the average adult weigh 29,880 grammes (65 lbs.). Thus the increase is 50-fold, while the total weight of the body is only increased 18- or 19-fold (from 7 to 126 lbs.). This immense increase in muscular tissue consists principally of albumen. On the other hand, the youthful organism is not designed for either great or prolonged exertion of strength. [Now it is the non-nitrogenous or carbohydrate part of the food,—the fats, starchy and saccharine substances,—which principally furnish the force expended in muscular action.] For these two reasons, therefore, we should expect to find in the nourishment of children comparatively more albumen and less non-nitrogenous substances than in that of adults.[1] Voit calculates that in the food of a four months' child fed with mother's milk, the albumen was to the non-nitrogenous substances as 1 : 1.82. In the food of a working man, it was as 1 : 2.9. According to Playfair,[2] the relation of nitrogenous to non-nitrogenous substances in the food of children of

[1] The above statement applies to the relation between food and muscular force. The nerve force which lies at the basis of all vital activities, depends ultimately upon the transformations of the albumen circulating in the tissues, and seems to be evolved from these. Voit, cited in the text, has, together with Pfluger, been prominent in demonstrating this.—Ed.

[2] *Edinburgh New Philosoph. Journ.*, vol. lvi., p. 266.

eleven years old, should be as 1 : 1.55. In the food of adults, 1 : 3.[1]

[These facts cannot be too much emphasized for the laity, who constantly imagine that fats, as cream,—or starches, as farina, arrow-root and corn-starch,—are more nourishing than milk because they are more solid. The reverse is true.]

The second important ingredient of the child's food is fat. This is required in a double way for building up tissues. It enters into their composition, particularly into that of nervous tissue, [and its presence seems in some way to facilitate the process of forming tissues]. The great nervous organ, the brain, grows proportionately more during childhood, and especially during the earliest years, than at any other time of life. At birth it weighs 385 grammes (about 13 oz.). At fourteen years, the brain weighs 1,241 grammes (2.73 lbs.), more than triple the initial weight. In adult life, (on an average,) the brain weighs 1,397 grammes (3 lbs.). For the great proportionate increase of the brain during childhood, fat in the food is essential. Carbohydrates are contained in the natural food of the infant, milk, in comparatively small quantity, and only in the form of sugar. Of the other carbohydrate, starch, there is no trace in milk. The great value of these articles of food lies in their power of protecting the fat and albumen of the tissues from the digestive decomposition, which they suffer in their stead. They thus nourish the tissues *indirectly*.

Inorganic salts are especially necessary to the growing organism, for without them no organized cell can be formed.[2] Besides their function in general tissue formation, the inorganic salts are especially important in the formation

[1] Hildesheim found for children 6–10 years old, the relation to be 1 : 2.04. But this is scarcely different from that of adults as calculated by Voit (see *supra*). It is possible that he simply observed the results of a prevalent practice. ("Die Normaldiät," 1856, p. 47.)

[2] Beneke.

of bone, of which an immense amount is formed during childhood. The skeleton of the new-born child weighs 445 grammes (about a pound); that of the adult, 11,560 grammes (25½ lbs.). The bones of a new-born rabbit contain only about 17 per cent. of mineral matter. Those of a rabbit eight months old contain nearly 40 per cent. This increased percentage—which does not indicate the absolute increase due to the increased amount of bone tissue formed by growth—depends upon the process of ossification. Of lime alone, the nursing child absorbs daily 0.37–0.40, (5–6 grains), in order to distribute it to its bones and other organs. At two months of age, the child imbibes in its mother's milk daily about 1.5 (23 grains) of inorganic salts, or 0.30 (4½ grains) for every kilo (2 lbs.) of its own weight.[1] According to Voit,[2] a grown person consumes less than 25 grammes (not quite an ounce) of inorganic salts daily, or 0.38 (6 grains) per kilo (2 lbs.) of his weight. This is a larger amount than is absorbed by the baby. But then the baby's tissues digest more salts, while in the adult a larger amount of the salts of the food pass away in the fæces.[3]

The relations of the different inorganic salts to one another in the nutrition of the child are of great importance. For the child at the breast it is easy to ascertain the proportion contained in its normal food—by analyzing the ashes of the mother's milk. We know very little, however, about this proportion in the food of older children. We do know, however, by chemical analysis of the different organs of the cadaver, that the ashes of each have a special composition; also, that these organs do not grow uniformly: one grows at one time, one at another; so it is evident that

[1] Farmers' wives are familiar with the demand of young chickens for mineral salts, which they give in the form of oyster shells or even egg shells.—Ed.

[2] *Loc. cit.*, p. 359.

[3] According to Rubner, the adult eliminates, without absorbing from the alimentary canal, 46.8 per cent. of the salt contained in cow's milk. (*Zeitsch. für Biol.*, 1879, xv.). According to Förster, the child thus loses only 36.5. (Ueber ausnutzung der milch im Darmkanals de Säuglings, *Aertzlich Intelligenzblatt*, 1879, p. 121.)

different salts are selected at different periods of growth. But about the details of this selection we are, so far, in the dark.

Deficiency of inorganic salts in the food of growing children—easily overloaded by their guardians—is a frightful source of nutritive disorder. Deficiency of lime especially tends to result in rickets.

Water is needed in comparatively larger quantities for children. Their tissues contain more water than the tissues of adults, and also eliminate more, both in urine and perspiration.[1]

The loss of water in the fæces is also much greater: in a nursing child of five months, four times as much as in an adult; in a child of five years, the loss was six times as much.[2] As therefore by all these ways the child loses more water than the adult, it necessarily requires to ingest more, in order

[1] Water in tissues of child's body = 66.4 %
" " " " adult's " = 59 %

The daily quantity of urine was for—

a child of 3 months,	520 grms. (1.10 lbs.)	per kilo	= 95 to 100 grms. (3½ oz.)
" " 1¾ years,	641 " (1.41 lbs.)	"	= 59.3 grms. (2.11 oz.)
" " 5 "	729 " (1½ lbs.)	"	= 40.5 " (1.4 oz)
" " 9 "	1,034 " (2.28 lbs.)	"	= 45.5 " (1.72 oz.)
an adult,	1,500 to 1,600 " (3¼ lbs.)	"	= 23.8 " (less than an ounce)

Camerer, *loc. cit.*, p. 29. The same author has also estimated the comparative losses in perspiration, in grammes—

for child of 3 months,	225 grms. (8 oz.)	per kilo	= 37. (1¼ oz.)
" " " 1¾ years,	356 " (12 7 oz.)	" " "	= 33. (1 oz.)
" " " 5 "	641 " (1½ lbs.)	" " "	= 35.6 (over 1 oz.)
" " " 9 "	556 " (1¼ lbs.)	" " "	= 25.6 (less than 1 oz.)
" " " 11 "	644 " (1½ lbs.)	" " "	= 27.1 (1 oz.)
adult during rest,	931	" " "	= 14.3
" " labor,	1,727	" " "	= 26.5

[2] Uffelmann: Child 5 months = 30 grms. per kilo = 4.5
" 5 years = 84 " " " = 6.7

Voit: Adult = 110 grms. per kilo = 1.7

to compensate the loss. The child is further incomparably more sensitive to an insufficiency in the water supply than an adult would be. This is especially true in cholera infantum, where the rapidly fatal course is often immediately due to the immense loss of water in the vomiting and watery purging. In the adult, an abundant supply of water produces—other things being equal—a greater excretion of nitrogen in the form of urea. This is due partly to a more thorough washing of the urea from the tissues;[1] partly to an increased decomposition of the albumen [circulating in them, and derived from the food].

It is not known whether the supply of water also influences the molecular decomposition of the fat of the food. Nor is it known definitely, whether in the child the same influence is exerted as in the adult. But this is on the whole probable; and the fact is of great importance in estimating the nourishment of the child at the breast; [and in appreciating the special physiological reasons which necessitate such watery food as nature provides during the first year of life. It may almost be said that, for the infant, the nutritive value of a food is in direct proportion to the amount of water contained in it. Watery food is more easily absorbed from the alimentary canal. But in addition, it facilitates more rapid chemical changes in the tissues; and in the infant, rapidity of tissue metamorphosis is essential.]

SECTION II.—NOURISHMENT DURING THE FIRST YEAR.

PHYSIOLOGY OF DIGESTION.

The alimentary canal of a baby is comparatively longer, and has a comparatively greater surface of absorption than that of the adult. In the latter the intestinal canal is four and one half times the length of the body: but in the baby it is six times. According to Beneke[2] a child under

[1] Voit, *loc. cit.*, p. 152.

[2] *Deutschen medicin. Wochensch.*, 1880, Nos. 32, 33.

twelve has an intestinal capacity of from 5,000 to 9,000 cubic centimetres to the kilo weight of the body; the adult only from 3,700 to 4,400.

The mucous membrane in the digestive tract of an infant is richer in blood and incomparably more sensitive, more easily injured, than at a later age. In muscularity this tract is materially behind the full-grown organism. Its functions are not fully developed at birth,—a fact of very great importance in children's dietetics.

Saliva exists during the first eight or ten weeks only in limited quantity, and in this period shows but slightly the property of forming sugar. This property is not wholly wanting, as was long believed, and the saccharizing of starch does actually take place much, but more slowly than in older infants, as has been shown by the experiments of Korowin, Sonsino, Schiffer, and others, and as I myself can confirm. After the elapse of the first eight or ten weeks, the quantity of the saliva and its power to form sugar increase, the latter reaching at the beginning of the fourth quarter of the year almost the degree possessed by the saliva of a grown person.

The stomach of the new-born infant offers important peculiarities. It is nearly cylindrical, has but a suggestion of a fundus, is less muscular, especially at the cardiac opening, and lies with the long diameter not transverse, but almost perpendicular, between the flatter diaphragm, the larger liver, and the abdominal wall. The fundus of the stomach forms very slowly during the course of the first year, and the long diameter as slowly assumes the transverse position. The capacity of the stomach is, according to Beneke—

on the	1st day of life,	about	40	cubic centimetres.	
"	14th " " "	"	160	"	"
in children of two years,		"	740	"	"

The mucous membrane, as is the case throughout the alimentary canal, is very vascular and very sensitive.

During the whole nursing period it reacts promptly upon slight changes of temperature or variations in the consistency and chemical composition of the food; and with incomparably more intensity than in later childhood. This sensitiveness, as well as the anatomical conditions mentioned above, especially the almost vertical position of the stomach, occasion the well-known marked tendency of infants to vomiting.

Since the investigations of Zweifel, Langendorff, Schmidt, and Sewall, there remains no doubt that the stomach of the new-born child contains a gland secretion capable of digesting. This gastric juice is probably less sour, *i. e.*, contains less hydrochloric acid throughout the whole nursing period than later; but on this very account is especially adapted to the digestion of caseine [in milk], though less potent for other albumen or for legumine and fibrine.

By observations of the stomach contents so frequently vomited by infants, I have estimated that the milk ingested normally leaves the stomach in about $1\frac{3}{4}$ hours.

SECRETION OF BILE.

Little is known about this in childhood. It has been assumed, but not at all proved, that the child, and especially the nursing infant, secretes a larger quantity of bile than the adult.[1]

Analysis of the fæces shows that in the child as in the adult, a good deal of bile is evacuated unchanged. The fæces contain both bilirubin (the coloring matter of the bile) and bile acids.

SECRETION OF THE PANCREAS.

[This great gland, lying in the abdomen behind the stomach, has been called the abdominal salivary gland, —because its secretion resembles saliva in the power

[1] The rapid tissue changes in children, which have been described in the text, associated with the abundant absorption and circulation of water, imply an activity of chemical process in the tissue cells, in which the cells of the liver must share, and which, under other circumstances at least, does result in an abundant secretion of bile.—Ed.

of digesting starch. The pancreatic juice is, however, more complex in its functions, for it not only digests starch, and far more completely than the salivary glands, which open into the mouth, have an opportunity to do, but it also changes albumen to peptone, and emulsifies fats so as to prepare them for absorption.] These two latter capacities are exerted from birth [so that the pancreas at once participates in the digestion of milk]. But the sugar-forming ferment does not appear until the beginning of the second month of the child's life.[1]

When milk is the only food, the healthy fæces of the child have the consistency of ointment, the color of the yolk of egg, a slightly sour odor, and a weak acid reaction. They contain small quantities of albuminates, fat and fatty acids, both free and in combination with bases; cholesterine, inorganic salts, especially lime; the acids of the bile and its coloring matters (bilirubin and urobiline), ephithelial cells [shed from the lining membrane of the intestine], water, and great quantities of bacteria. The dry portion is to the water as 15 : 85.

If only milk has been ingested, the fæces of a nursing child never have a putrid odor, owing to the antiseptic influence of the large quantity of bile. Conversely, the presence of such an odor proves that meat, meat broth, or egg has been eaten, and may thus serve to detect its surreptitious administration.

SECTION III.—PHYSIOLOGY OF METABOLISM[2] IN A NURSING CHILD.

In the child, as in the adult, metabolism is estimated by comparison of the food and oxygen ingested, with the various excreta eliminated. [These are principally composed of the residues from the food, after the portion required for

[1] Zweifel and Langendorff.

[2] "Metabolism" is the term used to express the chemical changes sustained by the food after it has been absorbed into the circulation and carried to the tissues.—Ed.

nutrition has been separated, fixed in the tissues, or consumed in the various vital processes.] In the child a third element has to be considered, namely, the process of growth, which is constantly going on, and which in the adult has ceased.

The composition of the nursing child's food—breast-milk—is well known. It is necessary to also know the precise amount which is daily ingested; and this has been carefully estimated. On the first day of life a child should drink 45–50 grammes of milk (1½ oz.).

From the second to the tenth the daily amount rises from 150 to 435 grammes (5 ounces to nearly 1 pound or pint).[1]

[As the amount drawn from the breast cannot be measured directly, it is calculated by weighing the nursling immediately before and after a meal.] In the third week the daily consumption of milk is 520 grammes (1 1/10 pints), and the amount increases gradually to the fortieth week, when it is 1,100 grammes (2½ pints).[2]

[1] Uffelmann calculated the following averages from numerous weighings:

1st day	= 45–50 grammes	(1½ ounces).	
2d "	= 150 "	(5 ").	
3d "	= 200 "	(7 ").	
4th "	= 260 "	(9 ").	
5th "	= 325 "	(11 ").	
6th "	= 360 "	(12 ").	
7th "	= 390 "	(14 ").	
8th "	= 415 "	(15 ").	
9th "	= 430 "	(15½ ").	
10th "	= 435 "	(1 pint).	

[2] Deneke, *Archiv für Gynakol.*, xv., p. 3, p. 281:

3d week,	about 520 grammes	(1 1/10 pints).	
5th "	" 650 "	(1½ ").	
10th "	" 800 "	(1¾ ").	
20th "	" 915 "	(2 ").	
30th "	" 975 "	(2 1/10 ").	
35th "	" 1,020 "	(2¼ ").	
40th "	" 1,100 "	(2½ ").	

See also Ahlfeld: "Ernährung des Sauglings an der Mutterbrust," 1878.

Hälmer: Ueber Nahrungsaufnahme des Kindes an der Mutterbrust und das Wachsthum im ersten Lebensjahre, *Jahrbuch für Kinder*, xv., I., p. 23.

Individual variations are, however, considerable. Ahlfeld, Camerer, and Hälmer have each estimated, on a child of his own, the relation of the quantity of daily milk to the weight of the body.

Ahlfeld's child, daily milk = $\frac{1}{7}$–$\frac{1}{5}$ (14 %) body weight.
Camerer's " " " = " " " "
Hälmer's " " " = 9.5 % " "
" " " " = 12–17 % " " (This in the 1st, 6th, 7th, and 8th weeks.)

The amount of milk taken does not, however, by itself, serve to estimate the nutrition. For Hälmer's child, weighing at birth the same as Ahlfeld's, namely, 3,100 grammes ($6\frac{8}{10}$ lbs.), took much less daily food, but thrived quite as well.

Upon an average the daily food of a child at the breast may equal $\frac{1}{7}$ the weight of its body, but this must not be considered a universal rule.

[It is a noteworthy fact] that when the child is fed on cow's milk a much larger amount is required daily than for a child nourished at the breast. This is probably due to the fact that the mother's milk is much more thoroughly digested, thus more thoroughly utilized in the tissues, than is the milk of the cow.[1]

[1] Hälmer's baby was put upon cow's milk in the 28th week. It immediately began to drink 200 grammes a day more than it had done hitherto. The following table gives experiments of my own on the daily amount of cow's milk drunk by a baby from the 10th day. Initial weight of child was 3,210 grammes (7 pounds).

10th day		560	grammes	($1\frac{1}{4}$	pints),	1 pint	milk + 2	water.
16th "		620	"	($1\frac{1}{3}$	"),	"	" +	"
25th "	(3d week)	710	"	($1\frac{1}{2}$	"),	"	" + 1	"
36th "		760	"	($1\frac{2}{3}$	"),	"	" +	"
50th "	(12th week)	800	"	($1\frac{3}{4}$	"),	"	" +	"
70th "		920	"	(2	"),	2 pints	" +	"
92d "	(23d week)	1,040	"	($2\frac{1}{4}$	"),	"	" +	"
116th "		1,200	"	($2\frac{2}{3}$	"),	"	" +	"
137th "	(34th week)	1,315	"	($2\frac{9}{10}$	"),	"	" +	"
152d "		1,375	"	(3	"),	9 "	" + 4	"
180th "	(45th week)	1,490	"	($3\frac{1}{4}$	"),	10 "	" + 3	"
210th "		1,500	"	($3\frac{1}{3}$	"),	undiluted.		

The table given in the preceding note may be compared with the tables in the notes on page 24—to show the excess of food taken when the milk comes from the cow.

THE EXCRETA.

These are urine, fæces, and sweat.

URINE.—The daily amount of urine excreted by a child at the breast is on an average, after the first few days of life, equivalent to 65–70 per cent. the weight of the food.[1]

When the child is fed on cow's milk, although, as already stated, the amount thus ingested is larger than when the milk is human, the amount of urine is not increased; it is indeed a little less. Thus Camerer's child, between the 211th and 245th day, for every 100 grammes ($3\frac{1}{2}$ oz.) of cow's milk consumed, excreted 60 grammes (2 oz.) of urine.[2]

[1] Camerer's child excreted as follows:

		1st day	48	grammes of	urine	($1\frac{3}{4}$	ounces).
		2d "	53	"	"	($1\frac{5}{6}$	").
		3d "	172	"	"	($6\frac{1}{9}$	").
		4th "	226	"	"	(8	").
		5th "	181	"	"	($6\frac{1}{2}$	").
		6th "	204	"	"	($7\frac{1}{4}$	").
From	9th to	12th "	357	"	"	($12\frac{3}{4}$	").
"	18th to	21st "	385	"	"	($13\frac{3}{4}$	").
"	31st to	33d "	398	"	"	($14\frac{1}{4}$	").
"	46th to	69th "	447	"	"	(16	").
"	105th to	113th "	517	"	"	($18\frac{1}{2}$	").
"	161st to	163d "	466	"	"	($11\frac{2}{3}$	").

—*Zeitsch. für Biol.*, xvi., I., p. 29.

Bouchaud (quoted by Vierordt in Gerhardt's "Handbuch," i., p. 140) gives:

For first	2–3 days	12– 36	grammes urine.
"	4–8 "	70–200	" "
From 2d to	10th week	250–437	" "

For every kilo (2 pounds) of body weight, about 90 grammes urine.

[2] The exact amounts were:

Daily milk taken	=	1,345	grammes ($2\frac{3}{4}$ pints).
" urine excreted	=	819	" ($1\frac{3}{4}$ ").

—*Loc. cit.*, xiv. and xvi., I.

The nitrogen [contained in the urea] in the urine of a child at the breast is much less than in that nourished on cow's milk. In the former it is 1.415 pints to 1,000; in the latter it is 2.86 to 1,000. [This implies that a larger amount of the albumen of the food has been retained to build up the tissues when the child is fed at the breast; while more albumen is wasted when the milk is from the cow.]

The fæces of a child at the breast are not copious, the daily amount being 10–40 grammes, according to the quantity of nourishment and the individual powers of assimilation. According to my observations 3 grammes of fæces may be reckoned for every kilo of body weight,[1] or every 100 grammes of food. But when the food is cow's milk the amount rises to 4 grammes for every 100 grammes of food.

Camerer has also estimated the daily amount of perspiration in his nursing child. When the child was living on its mother's milk it daily eliminated 26–46 grammes for every kilo weight of its body (1 to $1\frac{3}{4}$ ounces for every 2 lbs. weight), and 228–361 grammes for every kilo of milk ingested (8 to 12 ounces for every 2 pints of milk. There was no marked difference observed during the administration of cow's milk).

When we have thus ascertained the daily amount of food ingested and the amount of waste from the food daily excreted, it is possible to calculate what portion of the food becomes fixed in the tissues and increases their mass.

In the third week of life a child at the breast fixes daily in its tissues from its food 10,772 grammes of albumen (about 160 grains). This, therefore, is the absolute minimum of albumen required in the daily food. [See note, on page 28.]

Since the baby drinks 500 grammes of milk daily, and gains 30 grammes in weight, we may estimate an average

[1] Uffelmann, *Archiv für klinische Med.*, vol. xxviii., p. 442.

gain of 6 grammes for every 100 grammes of food, or 16 grammes of nourishment for every gramme of body weight (15 grains) gained.[1] But by the 150th day of life, or at nine months of age, a greater amount of breast-milk is required to secure an equal increase in weight. To gain 1 gramme, or 15 grains, 43 grammes of food are needed.[2]

As shown by the calculation in the notes, at the age of nine months the baby daily absorbs a considerable amount of albumen (8.921 grammes, or about 130 grains) whose utilization we cannot explain either by the gain in weight or by the waste matter excreted in the fæces and urine. [It is probable that this amount of albumen, unaccounted for in the observations quoted, has been oxidized to a stage beyond the waste product urea, and is eliminated in the respiration as carbonic acid. No experiments on nutritive

[1] The calculation is as follows:

Amount of milk taken,	= 500 grammes.	
Albumen contained in this,	= 11.50 grammes.	
Urine excreted daily contains . .	0.495 grammes.	
Nitrogen corresponding to . .	3.192 "	albumen.
Fæces excreted daily . . .	15 "	
Containing of nitrogen . . .	0.245 "	
This corresponds to	1.580 "	albumen.

The baby gains in weight about 30 grammes, containing 6.00 grammes albumen.

Then albumen represented by the nitrogen in urine =	3.192	grammes.
" " " " " " fæces =	1.580	"
" " " by gain in weight =	6.000	"
	10.772	"
Amount of albumen ingested	11.500	"
" " " unaccounted for . . .	.728	"

[2] On the 150th day the nursing child takes 950 grammes milk containing 21.85 grammes albumen (1 quart). It excretes daily:

660 grammes (7½ pints) urine containing 0.927 nitrogen.
28 " fæces " 0.456 "

0.927 grammes nitrogen in urine correspond to 5.988 grammes albumen.

0.456 " " " fæces "	" 2.941	"	"
Gain in weight = 20 grammes "	" 4.000	"	"
Daily minimum need of albumen =	12.929	"	"
	21.85	"	"
Superfluous albumen ingested =	8.921	"	"

changes are complete which do not involve analysis of the respiration—an analysis much more difficult than the examination of the urine for urea.] The estimation of the carbonic acid eliminated by lungs is [also] required, in order to follow the metamorphoses of the non-nitrogenous part of the food. All of this which is excreted from the body is eliminated as carbonic acid.

The nursing child receives in its mother's milk a much larger amount of fat than it can assimilate, for a large amount passes away in the fæces. As much as 20 per cent. of the dry residue of the fæces consists of fat. This fact is very important. It shows how necessary, for some reason, fat is to the body, and how impossible it is to replace it by other carbohydrates, as sugar or starch. But how much of the fat ingested is assimilated, or how much daily leaves the body under the form of carbonic acid, we do not know.

Comparison between the nutritive values to a child of breast and of cow's milk shows that a much larger quantity of the latter is required, though its nutritive ingredients are not increased in at all the same proportion. Thus on the one hundredth day of life, a child drank from the breast 830 grammes of milk ($1\frac{84}{100}$ pints); while another, of nearly the same weight, took 1,100 grammes of cow's milk ($2\frac{42}{100}$ pints). This cow's milk contained nearly twice as much albumen as the breast-milk, and three times as much salts; but rather less fat, and a good deal less sugar.[1]

[1] Child 100 days old, breast-fed, weighing 6,200 grammes (13 $\frac{6}{10}$ lbs.), imbibes :

	830 grammes	($1\frac{8}{10}$ pints),
containing albumen	19.08	(286 grains),
" fat	28.24	(1 ounce),
" carbohydrates	39.42	($1\frac{1}{2}$ ounce),
" salts	1.66	(16 grains).

Child 100 days old, weight 6,150 grammes, ($13\frac{1}{2}$ lbs.) imbibes :

Cow's milk	1,100 grammes	($2\frac{1}{2}$ pints),
containing albumen	32.8 "	($1\frac{18}{100}$ ounces),
" fat	26.3	(394 grains),
" carbohydrates	36.	($1\frac{1}{4}$ ounces),
" salts	4.3	(60 grains).

The urine of the child nourished on cow's milk, although greater in quantity, contained a larger amount of urea—that is of waste nitrogenous material than a breast-fed child. This corresponds to the larger amount of albumen ingested.

The increase in weight is sometimes greater in a child fed on cow's milk, but this is by no means the rule. When flour pap is given to a child, he receives a larger amount of carbohydrates in proportion to the fat and albumen. The same variation from the normal standard is observed with all kinds of flour preparations.

DISASSIMILATION OF SALTS IN NURSING CHILDREN.

Every 1,000 grammes of breast-milk contains 2 grammes of salts.

A child so fed, eliminates of	fæces	30	grms.	with	0.45	grms.	of	salts,
and "	" urine	650	"	"	0.38	"	"	"
					0.83	"	"	"
	Amount ingested =				2.00	"	"	"

Amount of salts retained in body = 1.17 grammes.

Chloride of sodium, or common salt, is one of the most important ingredients of the food, but we know little about its assimilation or elimination.

Phosphoric acid is excreted in a larger proportion to nitrogen than is the case with adults, and the same is true of sulphuric acid.[1] The rapid disassimilation of phosphoric acid seems to imply rapid nutritive metamorphoses in nervous tissue. Lime is assimilated in large quantity, as has been already noted.

[1] Zuelser, *Zeitschrift für praktische Medicin*, 1878. For a nursing infant of 3-6 months the daily amount of phosphoric acid in the urine is between 24-40, or on an average 30 pints for every 100 pints of nitrogen; while in the urine of an adult it is 19 pints.

A child of 12 weeks takes daily of breast-milk—

	800.	grammes ($1\frac{3}{4}$ pints),	
containing lime	0.500	"	
It discharges daily, fæces	25.000	"	
containing lime	0.125	"	} 0.128 lime
Urine containing lime	.003	"	}
			0.500 " ingested in milk.
			.372 lime daily retained.

The large amount of lime daily added to the tissues, 0.372 grammes, or over two grains, is required, as has been already said, partly for the formation of the bony skeleton, which at birth is soft and only beginning to ossify; partly for the building up of the soft tissues, for which it is also necessary.

CHAPTER III.

METHODS OF NOURISHING AN INFANT.

SECTION I.—NATURAL NOURISHMENT.

The natural mode of nourishing an infant is at the mother's breast. No other method ensures its welfare in like degree, no other can even approximately afford like protection from the most serious dangers of infancy. Therefore nourishment at the mother's breast must be striven for by all means, and in event of failure must still serve as a guide in each case of artificial nourishment.

Woman's milk is yellow-white, of sweet taste, and decidedly alkaline in reaction. Its temperature as it flows is about 38° C. Its specific gravity varies from 1,028 to 1,034. It contains in solid substances an average of about 11 per cent. Besides water, albuminates, fat, sugar, and salts are found in it. Opinions differ concerning the nature of the albuminates. According to some, milk contains two kinds of albuminous substances—caseine and ordinary serum albumen. But other writers claim that there is no caseine in woman's milk, but only albumen and peptone, as in the blood. In this way the milk would even more closely resemble the blood. Those who believe in the presence of caseine in the milk differ among themselves in regard to the precise condition in which it is found there, whether in solution, or only in minutely divided particles suspended in the fluid portion.[1] Assuming—as indeed has

[1] Hammarstein ("Zur Kenntniss des Caseins," Upsala, 1877,) and Kehrer (*Archiv fur Gynäkologie*, ii., 1) failed to demonstrate caseine in a filtrate of human milk. Biedert, however ("Die Kindernahrung," 1881, p. 87) claims to have found the caseine in such a filtrate, associated with serum albumen. He therefore infers that caseine is in the milk in solution.

always been done until lately—that there is real caseine in human milk, it is important to notice that its behavior to various reagents is very different from the caseine of cow's milk. These differences will be emphasized in speaking of the latter.

The fat of the milk exists in the form of little globules, and consists of the triglycerides of oleic, palmitic, and stearic acids. By some authors these globules are said to possess an albuminous envelope, which contains the fatty matter.[1] According to others, the envelope is composed not only of albumen, but of all the solid ingredients of the milk other than the fat.[2] Finally several authorities insist that the fat globules have no envelope, but swim free in the fluid.[3] Milk contains a special kind of sugar, known as sugar of milk, and several inorganic salts.[4] The quantitative analyses of human milk, which have been made by different chemists, vary considerably; and indeed the precise composition of the milk is extremely variable. The following table gives the average of several estimates:

COMPOSITION OF HUMAN MILK.

Nitrogen substances (caseine and albumen)	= 2.35 %
Fat	= 3.40 %
Sugar	= 4.85 %
Salts	= 20 %
Water	= 89.20 %

The variations in the quality of the milk depend upon the period of lactation, the nutrition of the mother, her constitution, condition of mental and physical health and [the coincidence or absence of menstruation].

[1] Raspail: "Chemie organique."

[2] Hartung: *Zydschrift. für nat. Gesch.*, xii.
Kehrer: *loc. cit.*
Radenhausen: Die Frauen milch, *Zeitschr. für phys. Chemie.*, 1881, 1., p. 13.

[3] Fleischmann: "Ueber Ernährung der Neugeborn. und Säuglinge," 1877.

[4] These are composed of potassium, sodium, lime, magnesium, and iron, united with phosphoric, sulphuric, and hydrochloric acids.

The milk secreted immediately after delivery is called colostrum. It has less water and a higher percentage of solid substances than is the case later, hence a higher specific gravity. The change begins in twelve to fourteen days, with an increase of water and diminution of solids; as the course of lactation advances, the principal solid substances, the albuminous and the fatty, continue to diminish, while the sugar slightly increases.[1]

The way in which a nursing woman is nourished, markedly influences the composition of her milk.[2] Poorly nourished mothers have poor milk, and the children fed on it, even though remarkably strong and healthy when born, soon cease to thrive. The fat in the milk, whose quantity is conveniently estimated by the lactometer, serves as a reliable index of the nutrition.

The foundling hospital at Moscow reports that the milk of wet nurses just arrived from the country, where they had been poorly fed, contains only 1.8 per cent. to 3 per cent. of fat, while those who had been at the hospital for some time, and been well nourished, had 3.20 per cent. to 4 per

[1]

Colostrum 1st day:	Water	= 84.08 %	Meymott.
	Nitrogenous subst.	= 3.23 %	Tidy.
	Fat	= 5.78 %	
	Carbohyd.	= 6.51 %	
	Salts	= .35 %	
" 4th day:	Water	= 87.98 %	Clemm.
	Nitrogenous subst.	= 3.53 %	
	Fat	= 4.29 %	
	Carbohydrates	= 4.11 %	
	Salts	= .21 %	
Milk on 12th day:	Water	= 88.5 %	
	Nitrog. subst.	= 2.45 %	
	Fat	= 3.80 %	
	Sugar	= 4.20 %	
	Salts	= .20 %	

[2] According to the tables of Vernois and Becquerel, the quantity of caseine of human milk increases (instead of diminishing) throughout the first month, then falls considerably. At the eighth month, however, the percentage again equals that of the first. It then again falls, and is at the lowest point in the eleventh month, but rises again on the twelfth. The quantity of fat diminishes throughout lactation.

cent. fat in their milk. I found in the milk of a girl fed on bread, coffee, and potatoes, only 2.3 per cent. fat; and after only eight days of good nourishment, the fat rose to 3.5 per cent.

Experiments on a female dog have shown that when pure animal food was taken, the milk contained more solid ingredients, especially more fat and sugar, than when vegetable food was given.[1] Wolff found the fat of the milk to increase with the amount of albumen taken in the food[2]; and the experiments of Külne and Fleischer show that caseine and fat increase in proportion to the albumen in the food, while the sugar is in nearly inverse proportion.[3]

The following table from Vernois and Becquerel and De Caisne summarizes the preceding data. The milk contained:

	Water.	Albumen.	Fat.	Sugar.	Salts.
1. With scanty nourishment .	88.30	2.41	2.98	6.07	.24
2. " plentiful " " .	85.79	2.65	4.46	6.75	.39
3. " very bad " .	89.57	3.87	1.88	4.37	.11
4. " " good " .	87.65	3.71	4.35	4.16	.13

These tables show that it is the fat of the milk which is most conspicuously affected by the quality of the nurse's food. The nitrogenous or albuminous substances vary much less.

Anæmic, cachectic mothers, or those affected by a chronic disease, have a scanty supply of milk, and it is poor in solid ingredients, except sugar. It is said that during acute disease (febrile?), on the contrary, the sugar diminishes, and the albuminoids, fats, and salts increase.

Very youthful and also old mothers have, as a rule, poor and scanty milk.

[1] Subbolin. *Virch. Arch.*, 1866, 36, p. 561.

[2] Wolff bei Jacobi: "Die Pflege und Ernährung des Kindes," 1877, p. 358.

[3] See König: "Nährungs und Genussmittel," 1880, II., p. 207.

CHEMICAL EXAMINATION OF A WOMAN'S MILK.

The details of this examination are given in the notes. For the laity it is important to know that the nutritive value of milk may be fairly, if approximately, estimated by: 1st. Determining the reaction with litmus paper. 2d. Estimating the specific gravity, with a very small instrument, as that of Conrad, which requires only 10 cubic centimetres of milk. The specific gravity should be 1029–1033. 3d. Estimating the amount of fat by a lactometer. The method of using such an instrument is generally described with each one which is sold. The principle of their use may be understood from Marchand's. This is a glass tube closed at one end, and from this end marked off in three equal divisions, of which each holds 10 cubic centimetres. Milk is poured in up to the fractional mark 10, then a few drops of soda are added, and ether to the fractional mark 20. The mixture is now shaken until the whole forms a homogeneous mass, when alcohol is added to the mark 30, and the whole shaken again. The fat then separates from the ether, and collects in a liquid layer on top of the column of liquid. From the thickness of this layer is estimated the amount of fat. Little reliance can be placed on the simple cremometer or cream measure, a simple glass tube into which the milk is poured and allowed to stand until fat slowly rises to the top. To be even approximately accurate, it is necessary to first separate the fat by means of ether and alcohol, as just described.

As has been shown by the tables, the amount of fat in human milk varies from 2 per cent. to 7 per cent., but under normal conditions not less than 3 per cent. nor more than 4 per cent. is to be expected.[1]

[1] Quantitative Analysis of Milk—*Estimation of Total Solids.*—Weigh a given quantity of milk, evaporate to dryness, and weigh the residue. This may be done rapidly as follows: Put 50 centigrammes of milk into a little platinum dish, previously weighed, and held by pincers over a small gas-jet until the water is evaporated and the residue has begun to turn slightly yellow. Then the residue may be weighed, and its proportion to the total weight thus ascertained.

MICROSCOPIC EXAMINATION OF HUMAN MILK.

This discovers the fat globules in varying sizes, from 0.001 mm. to 0.025 mm.[1] Fleischmann (*Klinik der Pädia-*

Determination of Albuminous Substances :

(*a*) Evaporate to dryness ; extract the fat from the residue with ether, and filter it off ; then extract sugar and salt with alcohol, and again filter. The last residue is the albumen sought. (Simon : " Handbuch der angewandten Med. Chemie," 1842, ii.)

(*b*) Or else, add pure burnt carefully dried gypsum (sulphate of lime) to the milk, evaporate, and treat the residue in the manner described under (*a*). Haidlen nach Hoppe-Seyler · " Handbuch der phys. und path.-anat. Analyse," 1875.

(*c*) Or, add acetic acid, and then precipitate the coagulated albumen with sulphate of soda. Brunner : *Pfluger's Arch.*, vii., p. 440.

(*d*) Or, mix 20–25 ccm. of milk with cold absolute alcohol ; filter the precipitate, and treat it with cold 60-per-cent. alcohol, which dissolves out the salts, sugar, and part of the fat. The remainder of the fat is then extracted from the precipitate with ether, leaving behind only the albumen and salts. Dry, weigh, and then reduce to ashes, which consumes the organic substances, and leaves behind the salts. The difference between the last two weighings is the weight of all the albuminous substances. Of these methods, I prefer that of Haidlen, which, though laborious, is very reliable. By means of it I found an amount of albumen varying from 2.03 per cent. to 2.91 per cent., the average being 2.37 per cent.

Determination of the Fat.—Add dilute caustic soda to a known quantity of milk, then ether, shake hard, and allow the mixture to stand for half an hour. Skim off the ether (which will have risen to the surface), add a fresh portion, and do the same as before. Repeat the extraction with ether, until a drop of it evaporates without leaving a visible spot (showing that it has taken up no more fat in solution). All the ether which has been thus used is then evaporated to dryness, the residue dried and weighed. This process is simple and trustworthy.

In the Haidlen or Simon process (*ut supra*), the fat is extracted with ether from the residue left by evaporating milk, and in which the albuminous substances are to be looked for.

The method of the lactoscope for the estimation of fat has been described in the text.

Determination of the Sugar.—The milk is precipitated with absolute alcohol, the precipitate dissolved in dilute alcohol, the solution filtered, evaporated to dryness, dissolved in water, and then the sugar in it estimated in the volumetric way by Fehling's solution. 148 ccm. of the solution correspond to 1 grm. of sugar.

In Ritthausen's method (*Jour. für practische Chemie*, xv., p. 329), the albuminous substances are precipitated by a solution of oxide of copper, and the precipitate filtered. A known quantity of the filtrate is mixed with Fehling's solution, boiled filtered through an asbestos filter, and the copper reduced in the hydrogen stream. 0.225 sugar gives 0.3008 copper. In the determination of sugar, not less than 4.2 per cent. nor more than 5.5 per cent. is to be expected.

Determination of the Salts.—Evaporate the milk to dryness, reduce the residue to ash in a weighed crucible, and weigh a second time. The difference between the weighings indicates the weight of the inorganic salts freed from the organic ingredients of the milk. I have found the amount to vary between 0.18 per cent. and 0.29 per cent., the average being 0.21 per cent.

[1] *Mm.* stands for the thousandth part of a millimetre.

trik) finds the very large globules strikingly numerous in very fat milk, also in the milk of old, feverish, or menstruating mothers, and, finally, when the lactation has been prolonged. The minute globules, looking like points, predominate in the milk of badly nourished women.[1]

Bouchut has proposed to count the fat globules by means of the instrument used for counting blood corpuscles.[2] A drop of milk from the breast is diluted with 100 drops of a 1-per-cent. solution of common salt, and a drop of the mixture placed upon a microscopic slide. [In Gower's instrument, hæmatometer as it is called, the slide contains a shallow cell, $\frac{1}{5}$ inch in depth, in which the drop is placed, and the bottom of this cell is divided into squares by a series of lines crossing at right angles. In some other instruments these squares are engraved on a piece of glass, inserted into the eye-piece of the microscope. The slide is then left quite flat.]

[The number of fat globules are counted which appear in a certain number of squares; and, by means of previous calculations made in connection with the instrument, and described with it, it is then possible to know how many fat globules are contained in a cubic millimetre of milk.]

But Bouchut found the milk of the same woman to vary so much, at the shortest intervals of time, that the method of enumeration cannot be of much value.[3]

[1] Deutsch ("Jahrbuch für Kinderheilkunde," ix., p. 309) controverts the above statement, and thinks it is not possible to judge the quality of the milk by the microscope.

[2] *Gazette des hôpitaux*, 1878, Nos. 9 and 10.

[3] Bouchut fails also to establish any fixed relation between the number of fat globules and the density of the milk or its percentage in fat. Thus with:

1,102,500	globules	to	1	c.mm.,	sp. gr.	= 1,022 — % =	2.4
1,182,000	"	"	"	"	"	= 1,021 — % =	2.1
1,925,500	"	"	"	"	"	= 1,030 — % =	2.6
2,205,000	"	"	"	"	"	= 1,032 — % =	3.7
2,305,000	"	"	"	"	"	= 1,030 — % =	3.5
3,760,000	"	"	"	"	"	= 1,030 — % =	3.4

There is, however, an approximate relation.

Microscopic examination is useful however, for detecting foreign elements in the milk, as blood or pus corpuscles, which indicate some abrasion of the nipple, or inflammation of the gland; or the colostrum corpuscles, characteristic of the milk of the first ten or twelve days, but whose appearance later indicates some morbid condition of the breast.

DIGESTION OF FOOD.

Sugar and albumen are most completely digested and absorbed; fat not so well; inorganic salts still less. Thus:[1]

Total digestion of			milk solids	= about	97 %
"	"	"	albumen	= "	$\frac{99}{100}$ %
"	"	"	sugar	= "	100 %
"	"	"	fat	= "	97 %
"	"	"	salts	= "	$\frac{89}{90}$ %

The part of the food which is not absorbed, passes out of the body with the fæces. A part of the fat is doubtless consumed by the bacteria of the alimentary canal. A small part of the sugar is doubtless transformed into the lactic acid, which is seldom absent from the normal excreta of children at the breast. The fat which is not absorbed from the intestines [none is absorbed from the stomach] remains partly as neutral fat [its natural condition], is partly broken up into free fatty acids, and partly forms soaps. All these pass away in the fæces. Among the inorganic ingredients the lime is the least well absorbed, only about 78 per cent. of that contained in breast-milk, and only 25 per cent. of that contained in cow's milk, where there is a much larger quantity than is required for the child's nutrition. All the soluble salts of lime are precipitated by the alkaline blood. It

[1] The table is prepared by Uffelmann. "Untersuch. über das mikroscop. und chemische Verhalten der Fäces natürlich ernährter Säuglinge und über die Verdauung der einzelnen Nahrungsvestandtheile."—*Deutsch. Archiv für klin. Med.*, xxviii., p. 437.

is probable, therefore, that they are only absorbed into the blood in combination with some organic substance, in which form they are able to retain their solubility in an alkaline fluid. According to Voit,[1] the capacity of the fluids of the body for taking up lime is very limited, and lime is only absorbed from the gastro-intestinal canal, in proportion as what has been previously taken up is given off to the bones, glands, and other tissues.

The absorption of food is very easily disturbed by irregularity in the administration of the food; by faulty composition of the digestive secretions; by inflammatory affections of the digestive organs; often also by dentition, even when no diarrhœa nor intestinal catarrh is present. In all these circumstances a larger amount of nutritive material than normal is excreted with the fæces. This explains the observation so often made, that teething children often do not gain in weight proportionately to their age.[2]

THE FIRST MEAL.

It used to be the custom to wait full twenty-four hours, and even longer, before putting the child to the breast, and in the meantime to administer sugar water, camomile, or fennel tea. In many localities it is done to this day. But there is not the slightest real reason to justify waiting longer than until the child awakens out of the sleep into which it falls after the first bath. We know that there is a digestive secretion in the stomach of the new-born child. Moreover, the child shows signs of hunger after the first sleep and grows more quiet when its hunger is appeased. It would therefore be downright unphysiological to wait longer; to say nothing of withholding nourishment a whole day. Experience teaches the perverseness of the former way of

[1] Physiol. des allg. Stoffwechsels. Hermann's "Handbuch der Physiol.," vi., 1, p. 381.

[2] Uffelmann: *Arch. für klin. Med.*, xxviii., p. 458.

doing and the correctness of the way here recommended, for the initial loss of weight observed in the greater number of new-born infants is larger and redeemed later when the first twenty-four to thirty-six hours are allowed to go by without other nourishment than the drinks mentioned above.

It is true that the objection might be raised that a large number of mothers secrete no milk on the first day. This is true; nevertheless it seems in such cases very much to the purpose to place the child at the breast, because the suction prepares the nipples and occasions an affluence of blood to the mammary glands, which assists the secretion of milk. Probably no one will in the present time advance the opinion that the first milk is injurious to the new-born infant. We know rather that the colostrum is very healthful, since, in consequence of its chemical composition, it is slightly cathartic in its effect and thus favors the timely discharge of the meconium.

But what shall be done when the babe finds no milk ready in the mother's breast? Never should the mistake be committed of giving sugars, syrups, or the decoctions mentioned above. The child needs nourishment, and if it does not find it in the mother's breast we must give it in another suitable form until the milk flows freely. The best food on the first day is cow's milk, diluted in the proportion of 1 : 3, and with the addition of sugar, in the proportion of 4 or 5 parts for every hundred parts of the mixture. On the first day the child will nurse two or three times; on the second day, six times, and after that seven or eight meals daily throughout the first year. During the first weeks the meals occur every three to three and a half hours, and there is no difference between day and night; but in later months the child drinks every two and a half hours, requires nourishment in the night much less frequently, and finally not at all.

The quantity which the child takes at each meal naturally becomes greater and greater, as the frequency of the meals decreases, and as the nutritive demands of the growing organism increase.[1]

The quantity of milk imbibed at each meal, like the total daily amount, is usually from $\frac{1}{40}$ to $\frac{1}{50}$ the weight of the body. Physicians have tried to find out whether a child could be made to digest larger quantities of milk during the first days of life, in order to cover the initial loss in weight of 220–330 grammes (8 to 11 ounces). But when new-born children are put to the breasts of women in whom an abundant flow of milk has already been established, they do not thrive. Their digestive and assimilative capacity is not sufficiently developed to permit of large quantities of nourishment.

It is extremely important not to allow the child to nurse oftener than every two and a half hours. With such intervals, the stomach is enabled to empty itself completely of one meal before it is called upon to digest another, and even a period of entire vacuity, *i.e.*, of complete rest, is thus secured. But in the absence of such rest, with too frequent and irregular feeding, disorders of digestion and arrest of the process of gaining weight are certain to follow.

It is very desirable that the six or seven meals should all be obtained in the daytime, and the child accustomed to sleep uninterruptedly from 11 P.M. to 5 A.M. [These rules are among those most frequently transgressed by unthink-

[1] Each meal on :

1st day,	10 grms.	(Camerer),	12.5 grms.	(Uffelmann).
2d	"	18	"	"	25	"	"
3d	"	35	"	"	28	"	"
4th	"	37	"	"	39	"	"
5th	"	58	"	"	51	"	"
6th	"	54	"	"	50	"	"
10th	"	71	"	"	69	"	"
21st	"	100	"	"	97	"	"
40th	"	108	"	"	106	"	"
105th	"	134	"	"			"

ing mothers.] A healthy child, drinking with good appetite, nurses for about twenty minutes, often pausing, and then recommencing.[1]

It is very injurious to toss the child about immediately after a meal, and liable to cause prompt vomiting.[2]

The nipples of the mother require careful attention. If badly formed, they should, during the last months of pregnancy, be daily drawn out by the suction of a breast-pump, and washed in brandy and water so as to harden the epidermis. After the confinement, also, the most scrupulous cleanliness is essential. After each nursing, the nipples should be washed in clean water, and dried with a piece of soft linen. If this is not done, drops of milk will remain clinging to the nipple, and will ferment. The products of fermentative decomposition are extremely irritating, and are liable to destroy the delicate epidermic cells by which the nipple is protected; a microscopic parasitic plant is also liable to develop—the thrush, or *oïdium albicans*,—and being transferred to the infant's mouth, to there excite inflammation of its mucous membrane, a stomatitis, or sore mouth.

It may seem of small importance, that a few epidermic scales should fall off from the surface of the nipple. But when this has happened, germs from the air or from fermenting milk are able to implant themselves on the exposed surface to there grow and multiply, and in so doing to excite inflammation. Thus is formed the exquisitely painful "crack" or fissure, so justly dreaded by nursing women. These in turn are the starting-point of abscesses of the breast-gland. Fortunately these are escaped in a large

[1] These pauses, when the cooing infant looks up to the mother's face bending over it, are among the most charming episodes of infancy.—Ed.

[2] When the child's digestion is laborious, the method known to all good nurses is much to be recommended: of laying the child on its abdomen obliquely across the lap, or supported by one hand of the nurse, who with the other rubs or pats the back until wind is belched up.—Ed.

number of cases of fissured nipple; but, on the other hand, when they occur, they have no other origin than such fissures.

If, in spite of preventive care, the nipple does become cracked, it is best that a nipple-shield should be used when the child nurses.

The medical treatment of the erosions lies beyond the limits of our subject. [It may, however, be noted, that one of the best applications to the fissured nipple, is a 50-per-cent solution of alcohol. A 2-per-cent. solution of carbolic acid is also excellent, but prolonged washing of the nipple is needed before allowing the child to nurse. Finally a solution of tannin and glycerine, 10 grains tannin, ½ ounce glycerine, ½ ounce water, is also to be recommended.] It is very important that the mother be abundantly nourished, and that her food contain a plentiful amount of albumen. Even in the first days after delivery the mother must not have too scanty fare. [It is well to allow forty-eight hours for recovery from the shock of the labor, during which the woman receives only milk or gruel, but this every two or three hours. Then, on the third day, to secure a movement from the bowels by an enema, and immediately begin to feed upon solid food in as great abundance as can be digested.

It is injurious to the child for the mother to take strong bitter beer, heavy wine, brandy, strong coffee and tea, strong spices, green vegetables, especially of the cabbage kind, onions, unripe fruit.

Light beer, in moderate quantity, with meals, an occasional milk-punch when fatigued, a moderate amount of coffee with milk, well-cooked green vegetables, and ripe fruit, are certainly not objectionable, unless experience discover some special idiosyncrasy in either mother or child. There is a volatile sulphuretted oil in the onion which is liable to pass over into the milk. But considering the

number of peasant nurses whose charges thrive while the habitual onion diet is continued, it is difficult to believe that this really does harm.

Numerous medicinal substances are eliminated in the milk. Such elimination has long been asserted of mercury and of narcotics, and mercurial elimination has even been utilized in the medicinal treatment of the nursling. But, curiously enough, it is in regard to these substances that a certain doubt now exists.[1] Lewald and Personne have found mercury in the milk; Kahler, have not.[2] We know, however, without doubt, of the elimination by the milk of Epsom salts, Glauber salts, iron, lead, zinc, soda, iodide of potassium, salicylic acid.[3]

Zukowski has shown that not only hungry nurses have a poor quality of milk, but also tired and overworked ones.[4]

WEANING.

This question must always be decided for each individual child; it is impossible to fix any one date. Jacobi makes the strange assertion that it is best to wean when the first group of incisors have been cut—two, four, or perhaps six. If these are unusually long in coming, then it is best to wean at the eighth or ninth month.[5] Bauzon advises an even earlier change.[6] He requires that breast-fed children receive in the fifth month, under all circumstances, some cow's milk; in the sixth month, to receive Nestlé's flour or Liebig's or Bouchard's soup; in the eighth month, cocoa; in the eleventh, veal and chicken broths are to be added, and with the appearance of the eye-teeth the breast

[1] Lewald: "Uber Ausscheidung von Arzneimittels aus den Organismus," 1867.

[2] *Aerztliches Correspond. Blatt*, 1875, 23, 2.

[3] Jacobi, *loc. cit.*, pp. 362, 363; also Pauli: "Uebergang der Salicylsäure in der Milch der Wöchnerinnen," 1879.

[4] Bericht des Moskauer Findelhauses pro 1881.

[5] *Loc. cit.*, p. 343.

[6] Du Sevrage, Paris, 1878 (Thèse).

milk may be cut off altogether, and the long-protracted weaning be accomplished.

Vogel, on the other hand, declares that it is most natural to leave the child exclusively to the breast so long as it thrives and the mother sustains no injury. But this only holds throughout the first year; at the end of that time the child should certainly be weaned.

The best method is probably that of Fleischmann, who decides according to the scales. If the daily gain remain for a length of time below the normal average, it is a sign that—although without actual disease—the nutrition of the child is not thriving, and some change of food is required. In the majority of cases this occurs about the eleventh month.

[It has been shown on the tables at p. 4, that during the first four months the daily gain is from 20 to 35 grammes (300 to 500 grains—¼ lb. a week). During the next five months it is 10 to 18 grammes (150 to 270 grains). Finally during the last three months of the year, it is from 6 to 10 grammes (90 to 150 grains).]

It is of the greatest importance that the weaning should be effected slowly. A sudden change from breast-milk is often followed by serious digestive disturbance, even amounting to gastro-intestinal catarrh. Even when this does not occur, the daily gain in weight is apt to be interrupted, while in slow weaning the progress may not be disturbed.

Demme [1] has called attention to the loss of weight occasioned by sudden weaning, which lasts three to five days, and amounts daily to 25–75 grammes (375 grains to 2½ oz.), even when there is no obvious disturbance of the digestive functions.

My own experiments have confirmed this assertion. In one case of sudden weaning, necessitated by the nurse's illness, a child of 10¼ months lost weight increasingly for six

[1] Jahresbericht über das Kinderspital, in Bern, 1873–'77.

days, and did not recover his original weight until fourteen days had elapsed ; in another child, in whom the process of weaning went on slowly during fourteen days, there was no loss at all, only the process of gain is a little more slow than before. If possible to avoid it, weaning should never be undertaken during hot weather. Arabian physicians, especially Rhazes, pointed out the dangers of this season, centuries ago, and their observations have since been confirmed, both by physicians and mothers.

METHODS OF NOURISHMENT DURING PROCESS OF WEANING.

If the weaning begins in the eleventh month, cow's milk should at once be given. Of all foods, this is the most similar to mother's milk. We give it then in the most digestible form, mixed with barley broth (2 parts milk to 1 part of the latter). The mother's breast is given still, but less and less frequently, the cow's milk and barley being substituted with corresponding growing frequency. In this way the child is best habituated to the new food ; this effected, the barley broth is little by little discarded. From this time on, the child is treated like one nourished artificially from the beginning, and makes the transition to solid food in a similar way, by means of meat broths and the yolks of eggs, finely scraped raw meat, *Zwieback*. If cow's milk does not agree with the child, it must on no account be forced to take it ; diarrhœa would ensue and seriously endanger the child. Under such circumstances, the final weaning must be postponed and begun again soon with another kind of food : meat broth, with yolk of egg, or Nestlé's flour. If weaning during hot weather is unavoidable, it is well to accomplish it with the last-named substances from the outset.

A bad habit, very widely spread, may be mentioned here, namely, that of slowly accustoming children from the fifth month on, or even earlier, to the food of grown per-

sons, by not only permitting but even compelling them to taste food—and solid food—prepared for adults. The mothers or nurses of these children think that this manner of weaning fulfils the purpose best, because it is very gradual. But they do not know that the digestive tract of the infant is not adapted to the assimilation of solid food, vegetable food, spiced food, that it very often reacts violently against such food, and that numerous diseases are to be traced back solely to this cause. If breast-children are attacked with affections of the digestive tract, the trouble is almost always assignable to dietetic mistakes of the kind here described.

REASONS FOR WEANING BEFORE TIME, OR FOR GIVING NOURISHMENT IN ADDITION TO THE BREAST.

One of the most frequent motives for premature weaning, is a decline in the quantity or quality of the secretion of the mammary glands. If such a decline occur, the cause lies either in disease of the mammæ, in a general disease, or in a complete change of the manner of living; but it often remains unexplained. It then belongs to the physician to decide in each separate case whether there is prospect that the milk should become again adequate, and to direct what shall be done for the child's nourishment in the meantime. The substitution of the milk of a wet-nurse, or the giving of nourishment in addition to the mother's milk, are the alternatives to be considered. The former is to be preferred in most cases, but is not always to be effected. As for the latter, it is considered injurious by many, because they think that a mixture of nourishments easily gives rise to digestive disorders. This is really the case with many children, but is by no means to be regarded as a rule. I say this on the basis of many years' experience, and rejoice that I am not alone in my opinion. If they were right who declare that it is reprehensible to give two kinds of milk, it would not only be impossible for

numberless children in private practice to thrive as well as they do, but the *crèches* especially would have few good results to point to, since in them most of the children receive the breast several times a day, and are fed besides. Let us hear the competent opinion of a physician in charge of a *crèche* touching this question. Mettenheimer, in Schwerin, assures us that during the five years' existence of the *crèche* in that city he never observed the injurious effects which general prejudice has imputed to the use of two kinds of milk. "We assert with positiveness," he adds, "that the system hitherto pursued in the *crèche*, of giving between times to children nursed at the mother's breast a proper mixture of milk, water, and sugar, has never occasioned any difficulty. It is indeed necessary that the diet of children to be fed in such manner be conducted very carefully and exactly in accordance with the principles which hold good for artificial nourishment, and which will be discussed further on. Otherwise there will impend over such children, in spite of their receiving the breast, just the same evils as over those which are nourished in an improper manner with cow's milk. (Compare the treatise of Mettenheimer, "Geschichte der Schweriner Säuglingsbewahranstalt in den ersten fünf Jahren ihres Bestehens," 1881.)

When the secretion of the mammary gland is defective in quality, it may be the result of improper nourishment, as has already been explained, or of disturbances of health, especially acute or chronic diseases. In the former case, a rational diet must be prescribed; in the latter, if there is no prospect of rapid improvement, choice must be made between a wet-nurse and artificial nourishment. It is true that many mothers with acute or chronic fevers have continued to give their children the breast. D'Outrepont narrates that women with typhus fever nursed their children without harm to the latter; Jacobi reports the same of some women suffering with typhoid fever, and Dewees

of a mother ill of yellow-fever; but it is running a great risk to make use of such isolated experiences in order to recommend the procedure as a general rule. I have three times observed typhoid fever in infants nursed by mothers ill with typhoid fever, and I am convinced that the transmission took place through the milk. Diphtheritis I also saw appear in a boy of four months nursed by the diphtheritic mother. Such experiences teach caution, and demand that at least in case of infectious diseases children be taken from the breast. In case of small-pox, Spamer[1] recommends immediate vaccination of the child, but does not withhold the breast. I should advise that the child be separated as soon as possible from the sick mother and vaccinated.

Menstruation.—The question of management, if the nurse or mother begin to menstruate, often arises, as the occurrence of menstruation during lactation is by no means infrequent. There can be little doubt that the milk is altered during menstruation, having less water and more caseine.[2] The same fact was ascertained by Vernois and Becquerel,[3] who found 4.7 per cent. caseine instead of 2.45 per cent., as had existed before. There was also observed a slight increase in fat and salts; a slight diminution in sugar. Clinically we notice that very many children are restless, or even have colic and diarrhœa, as long as mother or nurse menstruates. Still it must not be forgotten, in opposition to all this, that endless numbers of breast children show no change in their welfare, no standstill in gain during the menstruation, and also remain perfectly healthy and vigorous afterward. We shall therefore have to answer the question whether reappearance of the menses makes weaning necessary by saying that each case must be de-

[1] *Deutsches Arch. für klin. Med.*, xix.

[2] Archambault, *Progrès médical*, 1879, pp. 8–11 (7 per cent. less water and 8 per cent. more caseine).

[3] *Annales d'hygiène publique*, vol. xlix., 2d Se.

cided separately. If the infant thrive, in spite of the menstruation, or if there be but trivial disturbances which quickly disappear, there is not the slightest ground for premature weaning; but if the disturbances are persistent, and the child shows a decline in weight, even after the time of menstruation is past, it will be well to have a wet-nurse, or to pass over to artificial nourishment.

[The effect on the mother's health of the double nutritive drain of lactation and menstruation is to be considered, not only on her own account, but because, as the author has himself insisted, a weakened and anæmic woman gives poor milk. It is rare that such a woman can nurse longer than six months. It is well to remember also that a woman who menstruates while nursing is liable to become pregnant, as she is not usually during lactation.]

A new pregnancy unquestionably necessitates immediate weaning. Children nursed by pregnant women do not thrive, and often remain for years behindhand in their development, being pale and anæmic.

The milk of pregnant women is said by Archambault[1] to have less caseine, but more sugar and more fat. But, according to Davis,[2] all the solid substances diminish with a pregnancy, so that the milk becomes thinner and more watery. This change in quality is soon followed by a notable diminution in quantity. Finally, the act of nursing, exciting reflex contractions of the uterus, is very liable to induce a miscarriage.

For all these reasons, the physician must certainly forbid further lactation as soon as a pregnancy is known to have occurred. The few rare cases where nursing continues under such circumstances, without detriment to mother or child, are too exceptional to be considered in framing this general and positive rule.

[1] *Progrès médical*, 1877, pp. 8–11.

[2] *Trans. Am. Med. Ass'n*, 1855.

It occasionally happens that all the rules which have now been laid down are observed, that the mother remains in perfectly good health, and that nothing abnormal can be detected in the milk, and yet the nursling fails to thrive, and suffers from chronic dyspepsia. These cases have not been satisfactorily explained; but it is probable that our methods of examination are not yet sufficiently sharp to detect all deviations from the norm, and that such do in fact exist in cases like that just described. The course to adopt is the same as when the milk secretion of the nursing woman is clearly an unsuitable one; for if the scales show more than a merely transitory loss of weight in the child, provision must be made for other nourishment.

I add here a discussion of conditions which forbid a woman's nursing at all. According to the opinion of most physicians, syphilitic women should never nurse children. There are many, it is true, who declare the milk of such to be harmless, as Bauzon,[1] Gallois,[2] and De Amicis,[3] all of whom have recently dwelt upon this and tried to prove it. But even should this be absolutely correct, there is always the consideration that an infant may contract syphilis from its syphilitic nurse in other ways than through the milk. Besides, observations are not wanting which positively prove the transmission of syphilis through the milk; I need only remind the reader of the notorious case which Cerasi communicated a few years ago (Cerasi in *Gaz. med. di Roma*, July, 1878). The question whether children with hereditary syphilis ought to be nursed by their own mother is a separate one, and will be answered in another place.

Scarcely a doubt remains concerning the injuriousness of the milk of tuberculous women. Bauzon alone expresses

[1] Bauzon, "Du Sevrage," Thèse, 1878.

[2] Gallois, "Sur la question de l'innocuité du lait provenant de nourrices syphilitiques," Paris, 1878.

[3] De Amicis, in *Il movimento medico-chirurgico*, 1877, Dec. 12.

the opinion that scrofulous and tuberculous mothers may be allowed to nurse children; but I do not believe that any one is inclined to agree with him.

Chlorotic and anæmic mothers, for their own sake as well as for that of their children, must forego nursing, even though the quantity of milk is all-sufficient. The milk of such mothers is poorer in solid substances than it should be; added to this, experience shows that the children seldom thrive, usually becoming pale and miserable, without strength of muscle or power of endurance, and this often for a long time, even through life.

Nervous mothers, particularly such as are pronouncedly hysterical, should also not perform the function of nursing. That attacks of hysteria essentially alter the milk has been shown by A. Vogel.[1] He found in it much more water (almost 91 per cent.), less sugar (not fully 3.5 per cent.), less salts (1 per cent.), more caseine (5 per cent.). Parmentier and Dejeux also found that the milk of a nervous woman after each attack contained less fat and more water. Thus it is easy to infer that children would not thrive on such altered milk, and no one will deny that this is in reality very often the case. It is also certain that infants which receive the breast immediately after the mother has had a hard attack of hysteria may fall into convulsions. I myself have observed this repeatedly in cases in which there was absolutely no other cause for the convulsions to be found, and I draw the inference that in a severe attack of hysteria the milk may acquire positively toxic qualities.

It is said that strong emotions, outbreaks of anger, etc., may produce phenomena similar to those caused by severe hysterical paroxysms. I have not met with any thing of the kind in my own experience; I have only seen children show restlessness a short time after taking the milk of the mother while she is under strong excitement.

[1] Jacobi, *loc. cit.*, p. 347.

Apart from the special cases here discussed, it should be regarded as a fundamental rule that a mother, with sufficient milk, should always nurse her own child. [It would be well if the conscientious physician should refuse to attend the confinement of such women as announce in advance their refusal to nurse their children.]

[1] The lowest European mortality for nurslings—13 per cent.–10 per cent.—is in Sweden and Norway, where almost every child is nursed by its own mother.

In Wurtemberg, on the other hand, only 33 out of 100 infants were brought up at the breast. Their mortality was 13.5 per cent., while that of the artificially fed rose to 42.7 per cent. In Lower Bavaria the infant mortality reached the extraordinarily high proportion of 50 per cent.; here maternal nursing has become the exception.

In Munich the mortality of breast children is 15 per cent.; that of children artificially reared is 85 per cent.

In Berlin, according to the last estimate, only 30 per cent. of the children are fed naturally; the mortality also is 30 per cent.

The evil, that so many mothers are from the beginning or after some few weeks unable to nurse their children, can only be removed, when the physical education of the growing female sex is conducted according to sound principles; when precautions are taken for rational nourishment, rational clothing, adequate bodily exercise; and when in all hygienic regulations the main physiological mission is kept in view. Then the body will develop properly and the mammæ will, at the appropriate time, be capable of furnishing a good and abundant supply of milk. But if the hygiene of the growing race be neglected, it cannot be wondered at that constantly more women are found who are incapable of nursing their children. It is true that care of the maiden, the wife,

[1] These tables are taken from a statistical chapter in Uffelmann's treatise, which is not included in the translation.—Ed.

the pregnant woman, the woman in confinement, must do its share towards the accomplishment of the great end ; but it is clearly evident that in the physical education—the hygiene of the child,—the foundation must be laid.

CHOICE OF A WET-NURSE.

If a mother either cannot or should not nurse her child, we must try to provide for the child the breast of another woman.

The wet-nurse should possess the following qualifications :

1. She must be fresh, healthy, and free from those defects or disorders which forbid nursing—that is, she must not be anæmic, chlorotic, hysterical, epileptic, syphilitic, scrofulous, tuberculous; she must not even be from a family in which tuberculosis prevails.

2. She should be at least eighteen and at most thirty-two years of age. Experience teaches that between these ages milk is secreted in more abundance and of better quality than earlier or later.

3. Her delivery should have occurred at nearly the same time as that of the woman whose child she is to nurse. This condition is based on the observations communicated above, which show that the milk of nursing women changes its composition in different months of the nursing period.

4. The breasts, particularly the nipples, should be well developed. The former must not be flabby, but a little hard, elastic, rounded, and traversed at the surface with distinctly visible veins. The nipples must stand out so that they may be easily grasped, and must have no cracks or sore places.

5. There must be a sufficient quantity of good milk. The best proof that this condition is met is furnished by the nurse's own child, in case it is perfectly certain that it

receives no other nourishment than from her breast. The child must be examined thoroughly. (1) It must have the normal weight for its age and sex. (2) The cutis must nowhere be flabby or wrinkled. (3) It must be free from eruptions. (4) Its excreta must be normal. If the child has died, great precautions must be taken, not alone to find out the cause of death and whether the quality of the mother's milk had any thing to do with it, but to be sure about the quantity, since this very rapidly diminishes when the child no longer empties the breasts.

Although the examination of the child is the best means of forming a judgment concerning the nurse, physical, chemical, and miscroscopic examination of the milk itself should never be omitted.

The color of the milk should be yellowish-white, the taste perceptibly sweet. When a drop is allowed to fall into a glass of water it should form a slight cloud, and when shaken should mix with it.

The reaction should be alkaline and remain so for six to eight hours. The specific gravity should be 1027–1034. The contents of fat, proteine, sugar, and salts should be within the limits given, and should be determined by one of the standard methods for the analysis of woman's milk—for instance, that of Haidlen.

The specific gravity, the solid contents, and the fat (the latter by means of the lactobutyrometer) are easily ascertained, and their determination is in every case indispensable.

The microscopic examination must be made in order to observe the average size of the globules as well as to detect any abnormal bodies that might be present.

Conrad's process is practical for the physician. By means of the milk pump or with thumb and forefinger he draws off, two to three hours after the last nursing, ten to fifteen ccm. or more milk in a clean glass and observes:

(a) The chemical reaction.
(b) The specific gravity at 15° C.
(c) The microscopic appearance.
(d) The fatty contents, with the Marchand lactobutyrometer, which has been reduced in size by Conrad.

After all, only the combination of different methods of test can give the certainty which the interests of children demand.

THE WET NURSE'S MODE OF LIFE.

The nurse once chosen, her life must be regulated. Great care is necessary in this respect, because there is danger that the transition to circumstances different from those to which she has been accustomed, may affect the quantity and quality of her nourishment. This danger is best averted by allowing her to live in essentially her accustomed way, providing as nearly as possible the same food and drink, and setting the same time for her meals. Gradually she may be habituated to the family table, without, however, violating any of the principles which have been laid down for the nourishment for nursing women (see above). It is also necessary that the nurse should not, as is so often the case, be kept permanently unoccupied in the nursery from the moment she enters into her new position. Her life has almost always been such as to give her much exercise and to take her much into the open air. This must be considered, and light housework given her, and she should be sent much out-of-doors with and, if necessary, without the child.

For several reasons, it is needful for the mother of the child to keep continual and careful watch of the nurse, to see how she performs her duty. Since she nearly always belongs to the lower classes, she has many of their prejudices with regard to the care of a child; she will be only too apt to retain many bad manners and habits with the child she nurses, and will, through ignorance, neglect many an

essential thing. Therefore she should be watched and, if necessary, taught or earnestly rebuked. Particular care must be taken that she does not let the child have forbidden food. I have already drawn attention to the great tendency of the lower classes to try to accustom a nursing child prematurely to the food of adults, and many nurses injure their little charges by such a practice. I have clearly in mind a case in which a nurse gave a child only six months old peas and beans from her own food for weeks, without having an idea that she was harming the child, notwithstanding the fact that it very soon began to have diarrhœa. It is particularly needful to keep constant watch over nurses with regard to the quantity of their milk, as they frequently, from selfish motives, try to conceal a diminution in the quantity. The best means of controlling this is to weigh the child regularly, and once in a while directly before and after nursing. Finally, it is also imperative to have an oversight of the nurse's care of her own person.

SECTION II.—ARTIFICIAL FEEDING.

If the mother cannot nurse her child, if no suitable wet-nurse can be procured, or if the family is unable to bear the expense of one, there is no alternative but to resort to artificial modes of feeding as a makeshift. It is then important to select a food which shall imitate as closely as possible the mother's milk, which is the nourishment provided by nature.

The artificial food therefore, should contain in sufficient quantity all the materials necessary for the preservation and growth of the organism, and in as nearly as possible the same relative proportion in which they exist in human milk. There should, however, be no excess of these. In the consistency and temperature (38° C.), the food should also resemble the natural milk; and it should be introduced into the child's stomach with the same slowness and regu-

larity as the breast milk is accustomed to be received. Finally, the food should be of a kind little liable to be injured by being kept.

FOODS TO BE AVOIDED.

First, all solid foods, or even fluids of too great a consistency, for which the alimentary tract of the child has not sufficient muscular force. Second, any food containing cellulose or starch, because these are both difficult of digestion. Cellulose is not digested even by the adult; it is liable to irritate the mucous membrane, and always interferes with the digestion of even the digestible substances which may have been eaten with it. These circumstances are intensified for the child; during the first two or three months of life only very little starch can be assimilated by a child, because the digestive ferments adapted to starch, and which are entirely absent during the first month, remain, for a long time after their appearance, weak or little effective. Even when some starch digestion begins, as in later infancy, there is always danger that the part which remains undigested will ferment, giving rise to irritating acids, whose effect on the tender mucous membrane is most injurious. It has been already mentioned that the gastric juice of an infant is less acid than that of an older child. On this account great care is needed in the choice of the albuminous substances of the food, and which are destined to be digested by the gastric juice. It has also been shown, in discussing the physiology of digestion, that fat was of great importance in the food, because, after absorption, it became essential to the building up of the tissues. In this formative function it cannot be replaced by carbohydrates, (sugar or starch). Inorganic salts are equally necessary in processes of formation, and must therefore by no means be neglected. These are the principal physiological data to guide the theoretical choice of a food. Practically, must also

be taken into account, the cost of the food, and the facility of its preparation.

COW'S MILK.

In general, cow's milk, more than any other substance, closely resembles human milk, and is therefore first to be thought of as a substitute for the latter. Nevertheless there are certain important differences.

Thus, the reaction of cow's milk is uncertain, being sometimes alkaline, sometimes acid from the moment of being drawn; and always becomes acid with great facility. The specific gravity varies from 1029–1033.[1] The solid ingredients are the same in cow's and in human milk, but their mutual proportions are not the same. The cow's milk contains more solids, and less water. The excess of solids is especially marked in regard to the albumen and salts; less so in regard to fat. The sugar, on the other hand, is less in the cow's than in the human milk (see tables in note [2]). The milk of the cow, like that of the human female, varies according to the period of lactation. The colostrum, or milk secreted immediately after delivery, is much poorer in water, richer in proteine (albumen and caseine), sugar, and salts, the fat being about the same.

The milk also varies with the kind of fodder used. Palmseed cakes, malt, rye, bran, serve only to increase the fat, leaving the caseine and sugar unchanged.[3]

[1] The specific gravity of human milk ranges from 1028 to 1034,—*ut supra.*

[2] Mother's Milk =

Water.	Albuminoids.	Fat.	Sugar.	Salts.
89.2 %	2.35 %	3.4 %	4.85 %	.2 %

Cow's Milk =

Water.	Albuminoids.	Fat.	Sugar.	Salts.
87.6 %	4.30 %	3.8 %	3.70 %	.6 %

Variations in composition of cow's milk (300 analyses). König: "Die Menschl. Nahrungs.-und Genussmit.," 1880, p. 203.

	Min.	Max.
Amount of albuminoids or proteine:	2.04 %	6.18 %
Amount of fat,	1.82 %	7.09 %
" " sugar,	3.20 %	5.67 %
" " salts,	.50 %	.87 %

[3] Kühn: "Die zweckmässigste Ernährung des Rindviehs," 1878.

On the other hand, turnips and the residuary liquors from distilleries, though occasioning a greater flow of milk, deteriorate its quality, rendering it more watery. This same feeding with distillery liquors, with the spent or germinated malt from breweries, with kitchen swill and other substances in a state of partial fermentation, with oil cakes containing rancid oil, renders the milk acid from the beginning, or exceedingly ready to become acid.

Other articles of fodder impart a peculiar taste to the milk; for instance, turnip leaves, wormwood, leek, and others—like the first meadow grass in spring—are liable to render the milk cathartic for children.

[These facts show that it is necessary for the individual family using cow's milk for infant feeding, or the municipality where cow's milk is publicly sold for the same purpose, to personally or officially inspect the method of feeding the cows from whom the milk is obtained. The dangers of "swill-fed milk" have often been exposed in New York City; it is doubtful whether they are all completely avoided. Cows so fed are especially liable to become tuberculous; but the danger of tubercle is not limited to swill-fed cows. It has been recently shown pretty conclusively that tuberculous disease may, by infection, be excited in babies fed upon the milk of tuberculous cows. This is a matter of the gravest concern to public hygiene. Nor is tuberculosis the only infectious disease which may be conveyed in milk. In England many cases of typhus, scarlatina, and diphtheria have been explained by infection of milk when such disease was prevailing in the family of the milkman.]

[1] Municipal inspection of milk should decide:

1. Whether the milk offered for sale has been adulterated or skimmed. In Rostock any milk which has less than 10 per cent. of solid substances is considered watered;

[1] The following paragraphs are taken from the portion of Uffelmann's treatise devoted to public hygiene.—ED.

in Paris the limit is placed at 11 per cent.; in England at 11.5 per cent. The fat should be between 2.5 per cent. and 3 per cent.

Chemical analysis should be employed to detect starch, chalk, or gypsum.

The milk finally must be examined to see whether it is fresh or spoiled; whether it has an abnormal color; whether it is kept in clean vessels and in clean, dry places.

This police inspection, to be of value, must be systematic and unceasingly vigilant. It is an excellent plan to frequently publish the results of the analyses, that the inhabitants of the town may learn to know what establishments sell good milk, and what must be regarded with suspicion.[1]

These ordinary police regulations in regard to purity of the milk do not suffice to exclude from market the milk of diseased cows; nor that which, after being drawn from a healthy cow, may have become infected with germs of disease from members of the family owning the dairy or in any way occupying themselves with the milk. Stringent inspection of dairies and milk-shops has been enforced in England in response to the urgent recommendations of the hygienic and medical press. In St. Louis, Missouri, also, a dairy inspector has been appointed; and the Board of Health of New York has established regulations for the hygiene of the cow stables, and especially forbidding the use of distillery waste in the fodder of cows. In Stuttgart has been founded a complete milk establishment controlled

[1] The following is the police order for milk, published in Darmstadt, Nov. 26, 1879:

All milk must have a sp. gr. of 1029–1033.

When skimmed it must have a sp. gr. of 1033.

All milk with a sp. gr. under 1027 is to be considered as watered, and immediately confiscated.

All milk with sp. gr. over 1027, if after 24 hours' standing and skimming, the sp. gr. is under 1033 must also be confiscated. So also:

All skimmed milk with sp. gr. under 1033.

All milk must be considered skimmed which has less than 2.8 per cent. fat.

by a committee composed of one or more physicians, a chemist, and a veterinary doctor. This committee regulates the selection of the cows and their entire management and that of their stables, and positively secures healthful milk of normal standard in every respect. Similar institutions have been established in many German cities. They can, however, only be supported in large cities; and the price of the milk—40–50 Pfennige a litre, although not more than its cost justifies—puts it beyond the reach of poor people.

[In large cities milk, though coming in good condition from the dairy, easily becomes spoiled, or even infected, at the grocery stores, where it is too often exposed for sale. Even in the process of bringing fresh milk to the city on railroad cars from distant farms fermentation is likely to begin before the baby gets his meal. It is on this account that it has been proposed to sterilize the milk immediately after it is drawn, and then send it in hermetically sealed jars to the city. Or, by means of small sterilizers adapted to family use, the milk can be sterilized in the nursery. Thus a portion at least of the dangers which have been described may be averted.]

SPECIAL CONSTITUENTS OF COW'S MILK.—CASEINE.

This differs a good deal from the caseine of human milk. The latter coagulates imperfectly in the stomach, and also little, or not at all, under the influence of dilute sulphuric, muriatic, or lactic acids.[1] It will also stand a long time without coagulating. These differences have been recently studied by Kehrer (*Arch. für Gynak.*, ii., 1), and Biedert (Untersuch. über die chemisch. Unterschiede der Menschen- und Kuhmilch, *Virchow's Arch.*, vol. lx., p. 352). Both kinds of milk coagulate upon addition of a

[1] Simon: "Handbuch der phys. Chemie," i., 72. This peculiarity of human caseine had been observed by Voltelen, "De lacte humano," 1779; and by Meggenhofen, "Diss. sistens indagationem lactis muliebris chemicam," 1826.

little artificial gastric juice; but the human milk curdles in thin flocculi, the cow's milk in thick lumps and flocculi. The differences are not effaced by diluting the cow's milk, nor by rendering it markedly alkaline. In no way can the cow's milk be made to coagulate in the finely flocculent curd of human milk, although when diluted and alkaline the curd is much finer than usual. Biedert ascribes the difference in coagulation wholly to a difference in the nature of the caseine. Human caseine, when isolated and pure, is a clayey yellowish-white color, and alkaline; cow's caseine is pure white and decidedly acid in reaction. Human caseine alone is soluble in water, dilute acids, and an excess of artificial gastric juice.[1] Radenhausen, however, thinks that the difference between the two kinds of milk is not qualitative, but quantitative, there being less proteid substances in human milk, and more in the milk of the cow.[2]

Whatever the cause, it is evident that a marked difference exists; and that milk which coagulates in thin flocculi must be more easily digestible than milk which coagulates in little thick lumps.

The second albuminous substance of cow's milk, albumen, like the serum albumen of the blood, is characterized by coagulating upon heating. There is about one fourth as much albumen in cow's milk as there is caseine; but in colostrum, almost half as much (1 : 2.9); so that colostrum coagulates immediately upon boiling.

Probably there exists in both cow's and woman's milk a third proteid body, similar to peptone (lacto-proteine, galactine, albuminose[3]). This is obtained by boiling the filtrate from coagulated caseine.

The fat of cow's milk has, in the main, the same composition as that of human milk, but there are in addition

[1] See also Langgard, *Virchow's Arch.*, lxv., Heft 1.

[2] Die Frauenmilch, *Zeitschrift für phys. Chemie*, 1881, i., p. 13.

[3] Bouchardat et Quevenne: "Du Lait," 1857. Hammarsten. "Untersuch. ueber die Eiweisskörper der Milch," 1874–'77.

glycerides of volatile fatty acids. The fat globules are smaller, only .001–.01 mm., and seem certainly to be surrounded by an albuminous membrane, as is probably not the case in human milk. For in the latter, butter can be extracted by simply shaking the milk with ether, while in cow's milk this is only possible after the milk has been previously agitated with a solution of caustic potassa, capable of dissolving an albuminous membrane.[1]

In addition to the ordinary fat, the triglycerides of the fatty acids, lecithine, or phosphoglyceric acid, have also been found in cow's milk. [This is the more interesting, because lecithine enters into the composition of nervous tissue.]

The sugar of cow's milk is exclusively milk sugar, thus identical with that of human milk, but less in quantity. The sugar is liable to become converted by fermentation into lactic acid, which thus renders the milk acid, and causes its spontaneous coagulation. The lactic-acid metamorphosis is due to a special ferment, probably introduced into the milk by microscopic fungi. During the lactic-acid fermentation, Cohn's bacilli are developed in considerable quantity. This is promoted by a temperature between 24° and 28° Cent. A higher temperature causes the sugar to be converted into butyric acid; while a temperature a few degrees above zero checks the fermentation, and boiling destroys the ferment.

Hence the great advantage of boiling milk, or of raising it to a heat sufficient to destroy the ferment, as a means of preservation. After a while the ferment will collect anew; but even then the milk which has once been boiled yields less acid than the unboiled. This, according to Richet, is due to the fact that the boiling has coagulated the albu-

[1] However, all fat may be removed from cow's milk by a mixture of 1 pint of alcohol with 3 pints of ether; or by adding ether after the previous addition of rennet. But this does not conclusively prove the absence of an albuminous envelope.

men. Albumen exists in solution in the fresh milk, and it there favors the development of the organic ferments.[1]

Lactic-acid fermentation is also favored by the advent of a thunder-storm, probably because of the excess of ozone which is then in the air.[2]

For an analogous reason milk ferments more readily in broad shallow vessels than in those with a narrow neck; and also when shaken in bottles, not entirely full, but containing air. In both cases oxygen penetrates the milk more readily.

It is an interesting fact that the free oxygen in the milk disappears upon the occurrence of fermentation. It is consumed in the multiplication of the ferment. It is easy to divine that the preservation of milk in unclean vessels, and in unclean, badly ventilated rooms, must also favor fermentation, because the milk is exposed to infection from innumerable germs.

On the other hand, fermentation is checked, and coagulation retarded, by either boiling, or cooling to near freezing-point; by the addition of anti-ferments, as salicylic acid, boracic acid, or oil of mustard; or by the addition of substances capable of neutralizing acid—as carbonate or bicarbonate of soda, lime-water, or borax.

Finally, we must not omit to say that recent investigations have shown that milk may be coagulated without lactic-acid fermentation. Rennet coagulates milk, though a neutral or alkaline reaction be maintained. Rennet curdles soluble caseine by itself, and independent of any acid, and in the absence of milk sugar; while pepsine only acts in the presence of an acid.[3]

Cow's milk contains a much larger amount of inorganic substance than human milk; and the proportion of the dif-

[1] *Comptes rendus*, vol. lxxxviii., No. 14.

[2] Henrici, *Journal für Landwirthschaft*, 1863, p. 295.

[3] Uffelmann, *Archiv für Kinderheilkunde*, 1880, p. 416.

ferent salts is also different. There is less sulphuric acid, chlorine, and potassium; more phosphoric acid, lime, and iron.[1] Small quantities of oxygen, nitrogen, and carbonic-acid gas are normally contained in both cow's and human milk. But the cow's milk, which alone is liable to stand exposed to the air, has an unfortunate capacity for absorbing other, and especially, putrid gases. This is shown experimentally by letting an open vessel of milk stand in a room in which sulphuretted hydrogen was being evolved.

ADULTERATIONS OF COW'S MILK.

These consist in the addition of water, starch, flour, sugar, white of egg, salt, gypsum, or chalk. The milk may also be falsified by skimming off the cream.

The milk must be examined in the same way as has already been described for human milk. In addition is to be noted:

That the color must be yellowish-white, not bluish, nor reddish; taste sweetish; the chemical reaction neutral.

The so-called nail proof may be used to test the consistency. A drop of the milk let fall upon the thumb nail should not immediately spread out in all directions.

In examining for proteine substances, in addition to the methods already described, several others may be used, as detailed in the note.[2]

[1] In 100 parts of ashes from:

Woman's milk,	33.78	potassa.,	from cow's milk,	24.67
" "	9.16	soda,	" " "	9.70
" "	16.64	lime,	" " "	22.05
" "	2.16	magnesia,	" " "	3.05
" "	.25	iron,	" " "	.53
" "	22.74	phosphoric acid,	" " "	28.45
" "	1.89	sulphuric, "	" " "	.30
" "	18.38	chlorine, "	" " "	14.28

—König, *l.c.*, pp. 199 and 204.

[2] *The Hoppe-Seyler method.* (Handbuch der phys. und path.-chem. analyse, 1875, p. 454.)—He dilutes from 25 to 50 ccm. milk with a 10-20-fold volume of water, adds acetic acid and admits during half an hour a stream of carbonic-acid gas. The precipi-

DIGESTION OF COW'S MILK BY CHILD'S ORGANISM.

Examination of the milk vomited by a healthy child fifteen or twenty minutes after nursing, shows that when this is mother's milk there are only small fine clots, but that these are large and dense when cow's milk has been taken. Thus the two kinds of milk behave in the stomach just as they do in artificial gastric juice.

Occasionally, however, healthy breast-fed children do vomit thickly curdled masses. This is probably due to an accidental change in the mutual relations between the rennet ferment and the acid. According to Hammarsten, the

tated caseine and fat are collected upon a well-dried filter, the fat extracted with ether, and the caseine thus left is dried and weighed with the filter paper at 110° C. From the filtrate, at first clear as water, the albumen is precipitated, dried, and weighed.

The method of Millon and Commaille. (Comptes rendus, lix., p. 301.)—The milk is coagulated by means of acetic acid, the coagulum washed with water and then with 40 per cent. alcohol, next treated with ether to which a little alcohol has been added. That which remains undissolved is caseine. The filtrate of whey is divided into 3 portions ; the 1st serves for ascertaining the albumen ; the 2d, the sugar of milk ; the 3d, the ash.

Adam's method. (Comptes rendus, lxxxvii., p. 290.)—Ten ccm. of 75 per cent. alcohol which contains in solution 5 per cent. of sodium, are mixed with 10 ccm. of milk which has been made neutral and 12 ccm. of ether, placed in a glass tube and shaken ; the mixture is then allowed to stand five minutes. Two layers now form, the upper containing the fat, the lower the remaining ingredients. The latter is drawn off, diluted to 100 ccm. and 10 drops of acetic acid are added. The caseine precipitate is collected on a dry filter paper, washed, dried, and weighed. Albumen, which Adam takes little notice of, is in the filtrate, from which its amount may be determined.

Gerber's method (Zeitschr. für. anal. chemie, xvi., 252) is similar to that of Hoppe-Seyler, but the former ascertains the amount of caseine and albumen together, not separately.

Krocker's method. (Leitfaden für qual. anal., 1868, p. 170.)—Determination of the amount of proteine contained from the amount of nitrogen received in burning with calcide of sodium.

The fat is ascertained in the same way as with woman's milk, by extraction with ether, having previously added acetic acid or soda lye ; by applying ether extraction to the dry substance left after evaporation, or to the precipitate of caseine and fat obtained with chemical reagents ; further, by the lactobutyrometer, by the optical apparatuses, or by the cremometer. A special apparatus, not used for examining cow's milk only, is that of Soxhlet for fat extraction.

For determining the sugar contents we likewise make use of the same methods as with woman's milk ; *i.e.*, that by means of Fehling's solution after eliminating fat and albumen, and that with the polarization apparatus.

precipitate produced by rennet is thicker than that produced by the acid.[1]

Thus it is certain that the first thing which happens to the milk after entering the baby's stomach, is its coagulation into fine or coarse curds. The fineness of the human milk curds renders them much more digestible by the baby's stomach than the thick curds of cow's milk.

Further observations on the behavior of the milk in the stomach, have been afforded by the case of a boy with a fistulous opening into the stomach. The milk, in half an hour after drinking, separated into voluminous coagula, and a turbid, watery fluid. The latter became perfectly clear by filtration. After the lapse of $1\frac{1}{4}$ to $1\frac{1}{2}$ hours, this fluid seemed to have been nearly all absorbed, and only a thickish coagulum could be obtained from the stomach; after two hours, the coagulum also had disappeared—the stomach was empty.

The fæces of a child fed on cow's milk contain the same ingredients as when the milk has been human; but the proportion of proteine, fat, and salts is larger. The amount of fæces is larger when cow's milk is taken—thus 40.43 grammes for every 1000 grammes of milk (being only 30 grammes for the same amount of mother's milk). Thus [and this is a curious fact] there is a greater amount of milk taken, and also a greater amount of waste with the cow's milk; 94.5 per cent. of the latter is digested and absorbed.[2]

The addition to the milk of substances which lessen the density of the coagulum increase the amount which is absorbed.

[1] "Zur Kennhniss des Caseins und der Wirkung der Labfermente," 1877.

[2] There is absorbed :

of proteine	about	98.6	per cent.
" fat	"	96.5	"
" salts	"	54.66	"

The milk sugar disappears—is probably entirely oxidized.

[This fact explains why it is so important, with young infants, to dilute the milk with alkaline waters, or with barley decoction.]

CHOICE AND PRESERVATION OF MILK.

Many details have already been mentioned in regard to the inspection of milk and the official control of dairies; some more remain to be specified.

Thus I have pointed out the danger of feeding cows on swill, or the waste from distilleries. It is important to know that the best milk is obtained upon dry, not green fodder; and the best dry fodder is pure ground grain, especially oats, flax-seed, and lucern grass, together with a little chopped straw.

Besides the tubercular disease, whose danger has been described, the unfortunate purchaser of milk in towns must consider the possibility of the foot-and-mouth disease, and even splenic fever in the cows from whom the milk for his children is obtained.

The milk of cows affected with foot-and-mouth disease produces, when consumed unboiled by human beings, a special inflammation of the mouth,—aphthous stomatitis. The danger of the milk from cows affected by splenic fever has been experimentally proved, and indeed might have been anticipated theoretically before experiment.[1]

Milk is even occasionally offered for sale from cows affected with the epidemic pleuro-pneumonia. It is said then to have a disagreeable odor and taste, and an emetic effect.

In the treatment of diseased cows, medicines are not unfrequently given, which are capable of passing into the milk, as tartar emetic, iodide of potassium, arsenic, oil of turpentine, rhubarb.[2]

[1] Bollinger: Ziemssen's "Handbuch der spec. Path. und Therap.," vol. iii., p. 501.

[2] Of all diseases affecting the cow itself, tuberculosis is the most important in regard to its effect on human beings by infection through the milk. Although such

One alteration of the milk easily recognizable by the non-professional consumer, depends upon a peculiar disintegration of the proteid substances: ammonia is evolved, the milk assumes a peculiar slimy consistency, and may be drawn out into threads.

The milk is sometimes colored red by admixture with blood, coming from some abrasion of the cow's udder, and falling into the milk while it is being drawn off.

The red coloring matter may also get into the milk; or this may become blue from a pigment which forms during the development of certain bacteria. This is said to occur in milk which has been kept in warm damp places. It may cause acute gastritis.[1]

Those concerned in the hygiene of children, whether their own or the even more helpless children of the poor, must keep in mind all these many possibilities in regard to milk. To secure pure milk from healthy cows, energetic measures of public hygiene are necessary, many of which have already been described. Here a few more rules may be mentioned for the private inspection and preservation of milk in families.

Testing the reaction of milk with blue litmus paper is a method of examination equally simple and valuable. Fresh milk coming from healthy, rationally fed cows, and kept in clean vessels, is always neutral, leaving both blue and red

infection has not yet been positively proved, the suspicion of it is very strong. Gerlach ("Jahresbericht der königlichen Thierarzneischule zu Hannover," 1869) first formulated this opinion, and even believed that he had demonstrated the infection experimentally. Bollinger accepts this doctrine (Ueber kunstliche Tuberculose, etc., 52 Vers. Deutsch. Naturforsch. und Aerzte), and Virchow thinks that the positive results of experiment are sufficiently numerous to arouse suspicions (*Berlin. klin. Wochensch.*, 1880, 17, 18). Medical practitioners have also communicated cases which render it extremely probable that an agent of tuberculous infection is transmitted in the milk of tuberculous cows. (See Demme's case, "Jahresber. des Berner Kinderspitals pro. 1879." Also Uffelmann, *Archiv für Kinderheilkunde*, 1880, p. 433.)

[1] Mosler, *Virch. Arch.*, No. 43. Also Hermbstadt, "Ueber blaue und rothe Milch," Leipzig, 1833. Steinhof, "Neue Annalen. der mecklenb. Landwirthsch. Gesell.," 1838. Nalsen, "Studien über blaue Milch," 1880.

litmus paper unchanged.[1] Any milk, therefore, which reddens blue litmus paper is to be rejected.

The non-professional purchaser of the milk may also decide whether milk has been either skimmed or mixed with water, by using the lactoscope.[2] The habit of using these tests in families would exercise a valuable control over milk dealers.

[There is a widespread belief among the laity that it is desirable for an infant to be fed from the milk of only one cow.] But this belief is erroneous, for the milk in that case is much more likely to vary from day to day in richness. Individual variations are compensated when the milk from all the cows on one farm is mixed together.

TREATMENT OF THE MILK BEFORE GIVING IT TO THE CHILD.

It is always safer to boil purchased milk as soon as it is received, so as to destroy at once any disease germs by which it may have become infected; and also the normal, but dangerous ferments. The skin which forms on boiling is composed of caseine and cream, and must be removed, if only because it will not pass through the nipple. This loses about $\frac{1}{25}$th part of the proteine substance. If, however, instead of using open vessels, as is usually done, the milk is boiled in a pouch-shaped vessel with a narrow neck, no skin forms, and thus all loss is avoided.

Albu declares that when milk is heated under high pressure it is more digestible. But my own experiments with artificial digestion have not confirmed this assertion. [The sterilizing apparatus recently devised and even adapted for nursery use have already been described. They are much to be recommended. The milk is not raised to a

[1] The peculiar slimy alteration of the milk mentioned before in the text, would be alkaline from development of ammonia.

[2] The milk scales of Quevenne, very easy to manipulate; the cremometer of Chevallier, or the Feser lactoscope.

boiling point, but to a temperature sufficiently high to destroy ferments and organic germs. The milk, if then placed in vessels hermetically sealed, may, like other canned substances, be kept indefinitely without spoiling. Coagula of cheese and cream sometimes form during the process of sterilization, if the milk be rich; these must be removed.

Cooling apparatus have also been devised as a means of destroying the milk ferment. The method is less trustworthy than that of heat[1] [and does not profess to keep the milk for longer than twenty-four hours; while after heat sterilization it may be kept for weeks. It is evident, moreover, that in poor families the ice method would often be impossible]. Bicarbonate of soda is often added to milk to preserve it from acidity, but I doubt if it be innocuous for infants. Kolbe has shown that milk may be preserved by adding small quantities of salicylic acid: 0.5, to a litre of 15° Cent. will avert acidity for a week; 0.1 to a litre will suffice for a day. This must be stirred in until completely dissolved. The milk must be in a glass or porcelain vessel, not metallic, for then it would be colored.

But the entire innocuity of this method for the child has not yet been proven.

Thus steam sterilizing or boiling remains the preferable method,[2] and the first to be applied in the treatment of the milk.

In the next place it must be diluted, so as to reduce its excess of salts and proteine to a proportion resembling that of human milk. It is important that the dilution be not carried too far; important also to remember that a degree

[1] The process of Swartz has been much praised. The milk, as soon as drawn, is poured into high oval tin vessels which stand on ice, and cool down from 2° to 4° R. In ten or twelve hours the cream separates—and this, as well as the milk, then remains unchanged a long time—even longer than twenty-four hours.—*Deutsch. Vierteljahr. für öffentliche Gesundheitspflege*, 1880, third Heft.

[2] The belief of the laity that boiled milk tends to constipate the child is sometimes justified; and unboiled milk, when known positively to be pure, is better tolerated. —Ed.

of dilution which would leave the proteine and salts in right proportion, must diminish the fat too much ; since the amount of fat in the cow's milk is not excessive.

If a specimen of cow's milk, containing 4.4 per cent. of proteine, is mixed with three times its volume of water, the food contains only 1.1 per cent. of proteine. The infant therefore would be obliged to drink daily double the amount it would take from the breast in order to cover its daily need of albuminous or proteine substance.

Again, even assuming that the percentage of fat in the milk were 4 per cent., which is rarely the case, the above dilution would bring the proportion to 1 per cent., which is much too low. The salts also would be insufficient.[1] It has been asserted, but never proved, that an infant can digest only a one-per-cent. solution of cow's caseine. Forster's child of four months old digested all the proteine in a nourishment consisting daily of 1,217 grammes cow's milk and 300 rice water, for the fæces of this infant were entirely free from albumen. In an experiment of my own with a child of four weeks, cow's milk and water were given in equal proportions. The proteine contained in the daily quantum of milk was 14.5 grammes. In the fæces were found daily 4.16 grammes of dry substance, of which only 2.9 per cent. was proteine. Thus that which was taken was almost completely digested.

I maintain, therefore, that the dilution of milk with three times its bulk of water is improper and positively dangerous. Instead, the following rule is to be recommended :

If the milk be rich, having about 4.3 per cent. proteine, and from 3.8 per cent. to 4 per cent. of fat, let 75 parts of water be added to 100 parts of milk. The mixture will then contain 2.45 per cent. proteine and 2.3 per cent. fat.

If the milk be not so rich, having only 4 per cent. proteine and 3.6 per cent. fat, add 60 parts of water to 100 parts

[1] As shown above (p. 35), good human milk contains 2.65 % proteine ; 4.46 % fat ; 0.39 % salts ; 6.75 % sugar (or 4.16 %).

of milk, and about the same proportions of nutritive substance will then be obtained.

The new-born child, however, must, for the first two or three days, receive milk diluted with three parts water; then with two parts water for a month; then give equal parts of milk and water. At the beginning of the third month make the transition to 75 or 60 parts water for the 100 of milk. This nourishment may be continued to the end of the sixth month; when it is desirable to pass slowly to undiluted milk. This method I have pursued for ten years, and am so well satisfied with it, that I shall never exchange for any other. It is necessary to add sugar to the diluted cow's milk, as human milk contains 1.15 per cent. more sugar than cow's milk does. To 100 grms. of pure cow's milk we should therefore add 1.15 grammes of sugar. But to the diluted milk we must add 4.8 grms. sugar for every 175 grammes of the mixture, or a level teaspoonful to 150 grammes of milk ($5\frac{1}{2}$ oz.).

It is unnecessary to select milk sugar for the purpose, inasmuch as both milk and cane sugar are changed to grape sugar in the digestive canal and before being absorbed.

OTHER METHODS OF DILUTING MILK.

Instead of diluting with water alone, it is sometimes an advantage to mix the milk with decoctions of barley, thin gruel of oatmeal or semolina, solutions of gum arabic, gelatine, or isinglass, or veal broth. These liquids seem to render the milk curd formed in the stomach thinner, finer, and smaller,—hence more digestible; on this account a large amount of proteine material is absorbed and utilized by the baby's organism. This has been recently demonstrated by me in a whole series of observations.[1] It is true that these liquids, or many of them—as barley and oatmeal decoction—also contain starch, which is not present in the physiologi-

[1] Uffelmann, *Archiv für Kinderheilk.*, ii., 1880, p. 12.

cal food of the infant. But the amount of starch is very small. The total solid substance included in transparent barley decoction, made from prepared barley flour, is not more than 1.75 per cent., and this includes, with the starch, also proteine, sugar, and salts. So 600 grms. (21½ oz.) cow's milk with 400 grms. or 14 oz. barley decoction, would contain at most 3.60 grms. (54 grains) of starch, and this amount, distributed over the entire day, could not be injurious to the child.

With the barley is also administered one inorganic substance, which is relatively deficient in cow's milk [and which is important in the nutrition of both blood corpuscles and muscular tissue], namely, potassium.

Von Dusch highly recommends the addition to the milk of decoction of oatmeal.[1] [In general, it may be said that oatmeal is especially useful when the baby is constipated; barley decoction when the tendency, if any thing, is to diarrhœa.] These various liquids must be added to the milk, if at all, immediately before the child's meal. If the mixture is made so long before that it is allowed to stand, it will ferment. When solutions of gum arabic are mixed with the milk, the gum becomes changed into grape sugar in the stomach. Such solutions always have an acid reaction, and are therefore to be avoided. Gelatine solutions are not very palatable to the baby's taste. Otherwise there is no particular objection to them. Veal broth, which contains a good deal of lime, is a most excellent addition to milk, especially for children who show any incipient symptoms of rachitis.

Lactin has been recommended to assist the digestion of milk. Camerer found that, on the addition of lactin, cow's milk curdled in as fine flocculi as woman's milk, and was well absorbed.

[1] Virch. und Hirsch's Jahresbericht pro 1880, ii., 618 ; also Kormann, *Journ. für Kinderheilk.*, xiv., 2, 3, p. 238.

The temperature of the cow's milk—pure or diluted—should be 38° Cent. when given to the baby, and as nearly as possible kept at that temperature during the meal. [This may be done by giving only a portion of the meal at once in the feeding-bottle, and replenishing two or three times.]

The milk should be given from a bottle supplied with a nipple which necessitates suction. The act of suction excites the secretion of digestive juices in the stomach and intestines, and moreover causes the food to be ingested slowly. The opening in the nipple therefore must not be so large as to allow the milk to flow too rapidly. On the other hand, it must not be so small as to require too great an effort to draw it out. About twenty-two minutes should be required for a meal,—as for the child at the breast. The best form of mouth-piece is the long rounding nipple, made of rubber free from metal. Mouth-pieces of bone or ivory are too hard. The feeding-bottle of Maw and Thompson is much used. At the lower end of the rubber mouth-piece is an ivory plate, that prevents the mouth-piece from entering the mouth too far. This is attached to a rubber tube fitting into the mouth of the bottle, to which is attached another tube, of glass, which passes down into the bottle.[1]

From cups, children swallow too fast. The only advantage of cups lies in the facility with which they may be cleansed.

The cleanliness of the vessels from which the child receives its milk is of the utmost importance. Spores of microscopic fungi develop with the utmost facility in the organic material which so easily accumulates in feeding-bottles or other vessels which have held milk. The disease of the mouth known as "thrush" is often developed in nurslings by the impure feeding-bottle. The spores of the

[1] Improved modifications of these bottles are easily obtainable in America. The tube is usually of rubber.—Ed.

"oidium albicans," which generate this disease, have been found on both the inner and outer surface of the rubber tube.[1] At the Paris *crèches*, Fauvel found the rubber tubes of the feeding-bottles coated with milk coagula, full of bacteria, and the same swarming in the milk.[2] Out of 31 bottles, 28 were foul, although these had all received a superficial cleansing, by being laid in water. This is not enough: the rubber must be turned inside out.

In rinsing the bottles, white sand or common salt may be used; never, as so often happens, leaden shot. Bottles cleaned by the last-named means have, after a time, a dull, filmy appearance, caused by lead remaining in them. It is not long since I witnessed the danger that may accompany this. The one-year-old daughter of Major von M., in Rostock, had for some time suffered from repeated vomiting each day, for which there was no explanation. The most scrupulous observance of all dietetic rules brought about no improvement. One day I discovered a little china saucer filled with lead shot, asked for what it was used, and learned that it had been employed in cleansing the bottles. Milk which was in one of the bottles contained *lead* and traces of *arsenic*. Immediately upon forbidding the use of the shot, the vomiting ceased.

The daily amount of food required for a child is, as has been said, larger with cow's milk than with breast milk. The same intervals between meals are required as with a breast-fed child. The best proof that cow's milk is agreeing with the child is the tranquillity of the latter, a sufficient gain in weight, and the normal appearance of the stools.

During hot weather all precautions need to be redoubled. It is well known that it is bottle-fed children who are most liable to suffer from summer diarrhœa. The milk must be boiled as soon as received into the house, and

[1] Mettenheimer, Memorab., xi., 1; also *Schmidt's Jahrbucher*, 131, p. 61.

[2] *Med. Times and Gaz.*, June 4th.

tested by litmus-paper for acidity. If all the milk obtainable is sour, lime-water must be added until the reaction is neutral.[1] If it be found repeatedly sour, it is well, during the hot weather, to replace it by a decoction of Nestle's flour or Biedert's cream mixture [see *infra*]. Finally, if vomiting or diarrhœa set in, the milk must be omitted altogether; for experience has shown that the continued use of cow's milk under such circumstances may aggravate to serious proportions an originally slight gastro-intestinal catarrh.

OTHER FORMS OF MILK FOOD.

Besides cow's milk, given alone or diluted as has been described, it has been advised to feed infants on:

1st. *Sweet whey*,[2] which, as may be seen by the analysis (see note), bears very little resemblance to milk, or even colostrum, the butter and cheese having separated in the curd. It has been, however, especially recommended for new-born children.[3]

2d. *Buttermilk*,[4] from which the butter has been separated mechanically, and only carrying a small amount of cheese with it, much more closely resembles milk, for it contains 3.78 per cent. proteine, and human milk only contains 2.65 per cent. The fat is, of course, deficient; and in addition to the usual ingredients of milk, there is a special substance, lactic acid [derived from the fermentation of the sugar], and which lends the sour taste, considered agreeable by grown persons. Both these last circumstances, and

[1] An uncertain palliative.—Ed.

[2] Prepared by means of the dried stomach of a calf, or, still better, by the addition of some of the prepared rennet, which is now easily obtainable. The directions for its use accompany the bottle. It contains: water, 95.5%; proteine, .5%; fat, .03%; sugar, 3.6%; salts, .37%.

[3] Hennig, *Journal für Kinderheilk.*, 1874, p. 48.

[4] Composition of buttermilk: water, 90.62%; proteine, 3 78%; fat, 1.25%, sugar, 3.38%; lactic acid, .32%; salts, .65%.—König, *loc. cit.*, p. 226.

especially the presence of lactic acid, forbid [more than the occasional] employment of buttermilk in the nourishment of the infant.[1]

3d. *Goat's milk.* This contains more fat and salts than cow's milk, and has a peculiar penetrating odor.[2] The coagulation and general behavior of goat's milk closely resembles that of the milk from the cow, and, if given to children, it must be diluted and otherwise treated in the same way. But children often refuse to drink it. The one great advantage of the goat is, that this animal rarely has tuberculosis. Moreover, many poor families can keep a goat who could not afford a cow. It has been proposed to allow the children to nurse directly from the goat, laying them at its udder. Boudard recommends for such purpose the white hornless Cashmere goat, with its odorless milk, and says that Buffon, Guérin, and others, advised this method, and that it has been employed by the Poor Commissioners of Paris.

4th. *Mare's milk.* This, like ass' milk, in some respects, most closely resembles that of woman. It has an alkaline reaction, which it retains for several days, and the flocculi of caseine behave in a manner which has been described as half-way between that of the cow and that of the human female. However, the proportionate composition of mare's milk differs a good deal from that of human milk, and, practically, it cannot be counted upon as a dietetic resource, owing to the extreme difficulty of obtaining it.[3]

5th. *Condensed milk.* If milk be deprived of most of its

[1] The following special preparation of buttermilk has been recommended by Ballot, who gave it to his own children: To 1 litre of buttermilk, add 1 tablespoonful of flour; boil a few moments, and add 10 to 15 grains of sugar. If diarrhœa occur, use rice flour instead of wheat flour. Ballot claims to have given this to his own children with excellent results.—*Schmidt's Jahrb.*, 1886, p. 187.

[2] The composition of goat's milk is: water, 86.91%; proteine, 3.69%; fat, 4.09%; sugar, 4.45%; salts, .86%.—König.

[3] As is known, it is extensively used among the nomadic populations of Tartary and Southeastern Russia, and from mare's milk "kumyss" was originally made.—Ed.

water, either cane- or milk-sugar added to the residue, and the mixture kept in hermetically sealed air-tight boxes, it remains indefinitely in the same condition [like other syrupy preparations preserved by canning]. Such condensed-milk preparations are made extensively in Switzerland and North America. But they are so unsuitable for a child's nourishment as to be very unfortunate articles of commerce. Condensed milk contains 6 times the amount of proteine, $2\frac{1}{2}$ times as much fat, 8 times as much sugar, and 6 times as much salts, as human milk.[1] It admittedly, therefore, requires dilution. But, owing to the great excess of sugar, it is impossible to so arrange the degree of dilution as to bring both proteine and sugar up to the normal standard. If ten parts of water be added, we obtain 2.5 per cent. proteine, but the sugar remains still 8 per cent.—at least double the proper amount.

Complicated rules have been suggested for remedying this difficulty by the addition of albumen as well as water, thus the white of egg. [But these suggestions are equally clumsy and pedantic; by far the simplest and most satisfactory method is to have condensed milk used only for the morning coffee of adults and for the necessities of travellers, and to save children from its pernicious inadequacy.] We shall presently see that observations made upon children who have been nourished upon condensed milk almost all give unfavorable results.

6th. *The Cream Mixture.* This, recommended by Biedert, is one of the most elaborately calculated foods for children. The attempt is made to graduate its composition according to the age of the child, so as to imitate the successive changes in mother's milk. Cream and sugar are added at first to water, then to milk and water, in such proportions that:

[1] Average composition of condensed milk: water, 25.68 %; proteine, 12.32 %; fat, 10.98 %; sugar, 38.47 %; salts, 2.61 %.

Children in the 1st month receive 1 % caseine
" " " 2d " " 1.4 % "
" " " 6th " " 3.2 % "[1]

But this rise in proteine does not occur in human milk, and the cream mixture does not have enough fat and salts. Moreover, the mixture sours easily in summer, and the composition of cream is variable. Biedert has also prepared an artificial cream mixture that may be occasionally serviceable during short periods of time for feeble or sick children who are for the moment unable to digest milk. But it is entirely unsuitable as the permanent food of healthy children. [Better say at once that it is preposterous. White of egg is substituted for the normal albuminoid, caseine, and supposed to be rendered digestible by the addition of hydrate of potassium. Sugar and butter are also added.] This artificial mixture keeps better than the natural, and really seems to be more easily digested than that.[2] The

[1] The following is the exact formula:

For children in 1st month, $\frac{1}{8}$ litre cream, $\frac{3}{8}$ litre water, 15 grains sugar.
" " " 2d " $\frac{1}{8}$ " " $\frac{3}{8}$ " " " " " + $\frac{1}{16}$ litre milk.
" " " 3d " $\frac{1}{8}$ " " $\frac{3}{8}$ " " " " " + $\frac{1}{8}$ " "
" " " 4th " $\frac{1}{8}$ " " $\frac{3}{8}$ " " " " " + $\frac{1}{4}$ " "
" " " 5th " $\frac{1}{8}$ " " $\frac{3}{8}$ " " " " " + $\frac{3}{8}$ " "
" " " 6th " 0 " " $\frac{1}{2}$ " milk, 10 grains milk sugar, + $\frac{1}{4}$ " water.

—Biedert: Neue Untersuch., *Virchow's Arch.*, Bd. 60.

[2] The prescription for manufacture is as follows:

Stir 60 grammes of white of egg into 300–350 grammes of water, and add to this 4 grammes of potassic hydrate dissolved into 60 grammes of water. A jelly forms of potassic albuminate. Chop this fine, and, with the aid of heat, add 120 grs. of sugar, 150 of butter, and as much water as is necessary to obtain a milky emulsion. Then add the salts (sodic, phosphate, chlorides of sodium and potassium, hypophosphite of lime, ferric phosphate, carbonate of magnesia), and add enough water to bring the whole to 500 grms. The mixture contains, for every 1 part potassic albuminate (supposed to closely resemble human caseine), 2.5 parts fat, 4 parts sugar, 0.20 parts salts.

This preparation has a yellowish-white color, and the consistency of thickened broth, mixed with ten times its bulk of water; it forms a milky liquid which contains, in 100 parts, 1 part proteine, 2.5 parts fat, 4 parts sugar, 0.20 parts salts.

For new-born infants the dilution is to be at first with 16 times the bulk of water. With increasing age, cow's milk is to be added, in gradually increasing quantity. When the child is found to bear well an equal bulk of cow's milk and the artificial mixture, then the transition may be made to pure milk.

This preparation circulates in trade in boxes.

potassic albuminate dissolves more readily in artificial gastric juice than does the caseine of cow's milk. [But egg albumen belongs not only to another animal, but, belonging as it does to a bird, it comes from a distinctly lower class of animals than the mammalians to which both the cow and the human female belong. This fact alone should make us suspicious of egg albumen for the infant. It may dissolve in the gastric juice and be absorbed; but the important question is, how thoroughly can so foreign a form of albumen be assimilated by the tissues of the human body? Well-known experiments have demonstrated that when egg albumen is injected into the circulation of a mammalian animal, it passes out of the organism in the urine, while serum albumen, similarly treated, is retained. The white of egg, beaten up with water, sugar, and, if needed, brandy, is however an excellent temporary food, in cases of diarrhœa.]

FLOUR PORRIDGE. PREPARED FLOURS AND FLOUR SOUPS FOR CHILDREN.

The flours of grains have been long used for the nourishment of infants, first in the form of the well-known flour porridge or bread-and-milk porridge (*Mehlbrei* or *Semmelmus*), popular to this day in certain localities, particularly in South Germany. It was known even to the ancients, but only as a means of nourishment for the time of weaning. Two or three centuries ago it gradually came into use for children during the whole of the first year—condemned by most physicians, but persistently retained by the people. In some places it is prepared from wheat flour, water, and milk; in others from either *Zweiback* or white bread (*Semmel*), water, and milk. Sometimes no milk is used. Sugar is almost always added.

This widely popular food is, however, entirely unfit for children, for it contains,—as may be seen by the analysis,—

proteine, fat, and carbohydrates being in practically different proportions from those of milk,[1] and it contains, moreover, large quantities of starch, which the baby cannot digest at all. The human milk contains 1 part albumen to 2 parts carbohydrates,—the latter consisting exclusively of sugar. In the porridge, when milk and water and sugar have been added to the flour[2] the relation is as 1 to $4\frac{1}{2}$, or nearly as 1 to 5.

Besides all this, all the albumen in the flour part of the porridge is vegetable, which is much less easily assimilable than animal albumen. There is too little water, and the inorganic salts are different.[3]

The undigested starch of the porridge readily ferments; lactic, acetic, and other acids are formed, exciting diarrhœa. These acids interfere with the saponification of fat, hence with its absorption; also probably diminish the absorption of salts. It has also been claimed that lactic acid, penetrating the circulation and carried to the bones, dissolves out their lime, thus producing the softening and deformities characteristic of rickets. Finally, another bad effect of starch, and upon which less stress is laid, is that of decreasing the digestion of albumen taken at the same time. According to Demme, starchy food taken too early, or, later, in too great quantities, causes the white blood corpuscles to predominate over the red ones.[4]

[1] Wheat flour contains of proteine 13.50 %
Human milk " " " 2.65 %
Wheat flour " " fat 1.00 %
Human milk " " " 4.46 %
Wheat flour " " starch 66.00 %
Human milk " " " None.
Wheat flour " " gum 6.00 %
Human milk " " " None.
Wheat flour " " sugar 2.00 %
Human milk " " " 4.16 %
Wheat flour " " inorganic ash 0.80 %
Human milk " " " " 0.39 %

[2] 60 parts flour, 300 milk, 300 water, 50 sugar.

[3] In the flour the 0.80 % ash consists of 34 % potassium, 50 % phosphoric acid, 7.5 % lime, and is rich in magnesia, poor in soda.

[4] Jahresbericht des Berner Kinderspitals, 1879. This assertion can hardly be taken literally, for it would imply that leucocythæmia could be caused by starch alone. It is probably meant that the proportion of red corpuscles to white—which should be 300 to 1—diminishes; in other words, that the blood becomes anæmic.—Ed.

Flour porridge ferments very easily, especially in summer, and experience has condemned its use as actually dangerous. An immense number of cases of rachitis, of acute and chronic intestinal catarrh, and of obstinate marasmus are met with in children who have been brought up on flour porridge.

From this examination of the merits of wheat flour, it might be deemed unnecessary to consider the claims of any kind of grain. Oatmeal, however, is said to possess some especial advantages. It contains more albumen in proportion to the carbohydrates, and, according to some analyses, the proportion of albumen approaches that of human milk. It is always improper to use oatmeal in the form of porridge. But as a thin decoction, salted, sweetened, strained, and used to dilute the milk, it is decidedly useful, especially in children who are constipated. Unless this tendency exists there is often danger, as Jacobi has pointed out, that the gruel may cause diarrhœa.

Barley also, though most valuable as a diluting decoction, must not be used in flour form to make porridge, for the composition of such porridge is almost exactly the same as that of wheat-flour porridge.

Liebig's flour soup.—This is a preparation of flour [devised by the celebrated German chemist], in which the starch, the objectionable part of the flour, is digested, *i.e.*, turned into sugar, by means of malt, which contains diastase, before it is given to the baby. It has, therefore, a real advantage over the flour preparations which have been hitherto described. Its mode of preparation is described below.[1]

[1] Mix together ½ ounce of wheat flour and ½ ounce of malt flour, and add 30 drops of an 11-% solution of potassic carbonate. Then add 1 ounce of water and 5 ounces of cow's milk, and heat, while constantly stirring, over a moderate fire until the mixture begins to thicken. Remove from the fire, stir five minutes, heat again, and again remove when it thickens, and finally bring it to a boil. Continue boiling until a sweet taste has developed. Then remove and strain, and the mixture is ready for use. It has double the concentration of woman's milk, and must therefore be diluted with an equal bulk of water. It keeps an entire day ; later it sours. According to Liebig it contains 3.1 % proteine, 4.3 % sugar, 3.1 % fat.

Notwithstanding the advantages of the Liebig food, it contains too little fat, the proportion of the salts is wholly unlike that of human milk, and the albumen is only vegetable albumen. Finally, its preparation is extremely difficult, and takes too much trouble. [Jacobi has remarked, that its preparation demands more brains than the average mother or nurse is apt to be guilty of.] Liebig's soup is, however, the model for the numerous flour preparations which are now in the market, of which Nestle's and Ridge's food, and that of the Anglo-Swiss Condensed Milk Company, are the best known. These foods are all made of condensed milk and prepared flour, the starch in the latter having been largely converted into sugar by the aid of heat.[1]

The method of analyzing these flours is given in the notes.[2]

[1] Per-cent. composition of flour of :

	Water.	Proteine.	Fat.	Salts.	Starch and sugar carbolized.
Nestle.....	6.36	10.96	4.75	1.85	67.08
Gerber.....	4.39	13.69	4.75	1.45	75.72
Cham	5.84	10.33	5.02	1.74	76.00
Schuster.....	6.29	10.71	5.03	1.76	76.21
Furichs.....	7.32	14.88	4.26	2.45	71.09
Coffin	8.29	17.15	1.59	3.02	69.94
Ridge.....	3.98	9.05	1.95	1.13	83.59
Giffey.....	4.22	12.86	4.34	1.78	77.62
Sambuc.....	6.39	10.12	.88	1.04	81.65

[2] Examination of flours according to Gerber and Radenhausen :

1. Determination of the water-ash and phosphoric acid. Dry 4.0 of the prepared flour at 100° to 110° in a platinum dish, stirring often. Reduce the residue to ash ; weigh, and determine the phosphoric acid contained by means of uranium.

2. Determination of the fats. Place dried flour (2.0–3.0) in Gerber's fat-removing apparatus, allow the ethereal solution of fat to evaporate, dry and weigh the residue.

3. Determination of the soluble and insoluble carbohydrates. Extract with 50 % alcohol the flour deprived of its fat. Filter off with a suction-pump the clear liquid left at the top, wash the sediment with 50 % alcohol, and raise the whole of the alcohol solution to a volume of 500 ccm. Of these 100 ccm. are evaporated to dryness. The residue, after removing the ash, multiplied by 5, gives the quantity of soluble carbohydrates contained in the portion of flour used.

Pour 200 ccm. water and 20 ccm. hydrochloric acid upon the part left on the filter, heat 3 hours in boiling water, filter, neutralize, raise the volume to 1,000 ccm., and triturate with Fehling's solution the grape-sugar formed from the starch by the hydrochloric acid ; 108 grape-sugar corresponds to 99 starch.

4. Determination of the albuminates. They are all that is left after subtracting

They all have the advantage of being exceedingly fine and keeping extremely well [hence are useful in travelling and emergencies]. But, if considered as the principal food, the disadvantages quite preponderate. There is a proportionably large amount of carbohydrates, and much of this is starch. All the proteine of the flour is vegetable—[the remainder comes only from condensed milk,—far removed from the normal food of the child, not only by its composition, but by its entire loss of vitality]. And finally, the amount of fat—so essential to the formation of tissues, and especially of the nervous tissues—is altogether inadequate. Thus the nutritive value is far below that of [any form of animal] milk, even when the elementary chemical composition approximates it. A large proportionate amount of the flours escapes absorption, and, correlatively, the waste material excreted as fæces is much larger.[1] Zweifel found in the cadaver of a child, who had been fed on Nestle's flour, that the contents of the entire large intestine consisted of starch. [The persistency with which these foods are brought before the public, and new preparations invented, the facility with which mothers delude themselves in regard to their nutritive value, makes it imperative to be emphatic in their condemnation, even more so than the author has judged necessary. The analyses and observations cited are quite sufficient to condemn these flours and all flour preparations; there is not the slightest reason to prefer them to milk or its preparations, except that the latter require more care; and for any intelligent and affectionate mother this reason is quite insufficient. It cannot too often be repeated that the nutritive value of a food cannot be sufficiently

.5 % for cellulose when the flour is made with wheat flour and 1 % for cellulose when made with oat flour (or with leguminose).

The preparation of children's nourishment from these flours varies sometimes according to the substances contained. Usually 1 tablespoonful is mixed with 6 tablespoonfuls of water and boiled 2 or 3 minutes.

[1] For a daily nutriment of 200 grammes of Nestle's flour 63 to 70 grammes of fæces.

tested merely by a limited amount of personal experience, for it is possible to observe half a dozen babies pass through their infancy with such food, yet escape disaster, and even apparently thrive. Still less is it possible to judge from a few weeks' experience with one child, who, during this time, may easily remain free from digestive troubles, perhaps even recover from those which had developed under a diet of cow's milk. But the test, which cannot be empirically applied, or in which only experience is useful when on a large scale and combined with scientific analysis of all the conditions of nutrition and development, is the suitability of the food for building up tissue. During this first year the baby is building up tissues and organs that are to last him throughout life; and these will work well or ill according to the degree of perfection and precision of structure which they attain at the beginning. And this depends to an immense extent upon the suitability of the food, not only to be digested, but to be absorbed, and then to be assimilated and organized. So mysterious are the properties of the molecules of albumen and fat, when once they have been thrown into the whirl of the living organism, that we must strive to deviate as little as possible from the exact forms given to us in nature, if only because we do not know what remote effects might result from the deviations. If nature provides the albumen of milk and a living fluid, we cannot expect the same results from any other albumen, or from long dead organic matter, as condensed milk.]

MALT EXTRACTS.

This preparation, of which the best and best known is Mellin's food, remains to be described, and is of real value if used in combination with milk. It is essentially the same as Liebig's soup, but so prepared as to be marketable. In all these malt extracts it is claimed that the starch of flour has been converted into sugar by the diastase of malt. The

flour may be first dissolved in water and the solution used to dilute the milk, or the powder may be added directly to the milk. [In either way the milk is rendered more digestible.] The nutritive value of the extract alone is low, but when it is added in this way to milk an excellent food is obtained. [It often, however, does not agree with infants during the first or even the second month.]

Maizena, arrow-root, corn-starch, all consist almost exclusively of starch, and are not admissible as foods for children under six months old, and only very sparingly, if at all, under a year.

PREPARATIONS OF EGGS.

These are of limited utility. Preparations of the yolk of egg contain substances foreign to mother's milk, called extractions; and the proteine is peculiar, and known as vitelline, a mixture of caseine, albumen, and nucleine.[1]

White of egg is more useful, for, mixed with sugar and water, it is useful in diarrhœa.

MEAT BROTH.

Meat broth, prepared in the usual way, contains but little proteine ($\frac{1}{2}$ per cent.) and fat, no carbohydrates, but most of the extractives and salts of the meat, together with varying quantities of lime, which was formed from the connective tissue during the boiling. Thus it is not to be regarded as a substitute for mother's milk. Mixed with yolk of egg, it has more proteine and fat, but is still without carbohydrates, and should not therefore even in this way be given as exclusive nourishment. If meat

[1] Composition of yolk of egg: proteine, 16.5 %; fat, 21 %; salts, 1 %; extractives, 9 %; water, 52.5 %.

The salts comprise, as compared with those of woman's milk, more sodium and iron, much more phosphoric acid, much less potassium and chlorine. Martini recommends a mixture made of the yolk of one egg; milk sugar, 6 grms.; water, 100 grms. I have found this occasion excessive flatulence in babies.

broth be added to cow's milk, the child receives the latter in a more digestible form, and the extractives or salts of the meat besides, so important in many disorders.

Bottle *bouillon* [1] contains more proteine, extractives, and salts than the common meat broth. Prepared from beef it contains:

water	proteine and glue	extractives	salts
92.65 %	2.82 %	2.95 %	1.58 %

In the ashes of bottle bouillon of veal there is more phosphoric acid and less potassium than in bottle bouillon of beef. The latter contains in 1.73 grms. salts, .71 potassium, and .42 phosphoric acid.

Beef tea is very frequently made use of in England and North America as part of the nourishment of infants. It is prepared as follows:

Cut beef very fine, after removing as much as possible of the fat, and pour over it 6–8 times the amount of fresh water. Heat over an alcohol flame, let it boil 3–5 minutes, and filter through a fine cloth, taking care to press out all the juice. Broth prepared in this way contains in all essentials the ingredients of the common broth, and has therefore the same effect. Jacobi warns us against its use, especially for infants with diarrhœa, and advises never to give it unless with a gelatinous fluid (barley gruel), or with beaten white of egg, as otherwise the salts it contains are too irritating to the mucous membrane.

COMPARATIVE VALUE OF DIFFERENT METHODS OF FEEDING.

Mortality statistics everywhere show beyond contradiction that children fed at the mother's breast are the ones which live under the most favorable conditions. Some of these statistics have already been given.

[1] Uffelmann, Ueber die Flaschenbouillon, ihren diätetischen Werth, etc., im *Archiv für Kinderheilkunde*, i., pp. 95, 96.

The child at the breast develops [other things being equal] most evenly, and is apt to retain its advantage over the child artificially fed. Russow[1] made 4,100 measurements of weight and length, and found that with artificial or mixed feeding both fall behind. At the end of the first year the average weight of children at the breast was 9,930 grammes, and length, 73 cm.; of children with mixed nourishment, the average weight was 7,430 grammes, the length 66 cm.[2]

Russow's figures, though striking, are not entirely conclusive, for the author does not show that the artificial food when used had been rationally chosen or properly given; appearances are that the contrary was often the case. However, his figures clearly illustrate the steady thriving of breast children, and their continued sturdy development in later childhood.

That the nourishment of children at the breast of a wet-nurse has not the full value of nourishment at the mother's breast, has been stated and confirmed in another place. Of the methods of artificial nourishment, that with cow's milk, if only conducted upon correct principles, has the best results to show, as the reports of all physicians agree. At

[1] "Beobachtungen über den Einfluss der natürlichen und künstlichen Ernährung auf Gewicht und Länge des Kindes," 1879.

[2] Of children under full strength at birth, those nourished at the breast weighed after twelve months 7,910 grms., measured 69 cm.; those with mixed nourishment weighed after twelve months 6,823 grms., measured 63 cm.

According to the same author, the difference in development existing at the end of the first year does not disappear until very late, and often not at all, at least not during childhood.

For children at the breast showed	at end of 1st year,	9,930 grammes,
	" " " 4th "	14,200 grammes,
	" " " 8th "	20,700 grammes;
while those artificially nourished showed	at end of 1st year,	7,430 grammes,
	" " " 4th "	12,000 grammes,
	" " " 8th "	18,300 grammes.
Furthermore, children fed at the breast measured	at the end of 1st year,	73 cm.,
	" " " " 4th "	93 cm.,
	" " " " 8th "	116 cm.;
while those artificially nourished measured	at the end of 1st year,	66 cm.,
	" " " " 4th "	87 cm.,
	" " " " 8th "	113 cm.

first a child with this nourishment usually gains weight, but slowly; the initial loss of weight, as was mentioned in another place, is greater and lasts longer in infants fed with cow's milk than in those nourished at the breast. This, of course, lies in the greater indigestibility of cow's milk, to which the child only gradually becomes accustomed; but when it has progressed thus far and digests the cow's milk well, the daily gain in weight rises to the normal measure. Yes, it sometimes is undoubtedly the case that an infant fed with cow's milk even outweighs one at the breast. This is a fact which is well known to non-professionals and stress is laid upon it by them when the physician enters the lists for natural nourishment; but this greater gain, which is explained by the greater quantity taken and the greater nutritive value of cow's milk, is by no means so frequent that it can be looked upon as a rule. In general, the child nursed at the breast retains the foremost rank, as is clearly shown from what has already been said. That which weighs much heavier in the scales in judging of the real worth of cow's milk for infants, and decidedly lowers the value of the latter, is the fact, which needs no further confirmation here, that feeding with cow's milk is much more frequently followed by both acute and chronic diseases of the digestive tract than nourishment at the breast of mother or wet-nurse, and that the severest and most serious of these, summer diarrhœa, is its especial accompaniment. Added to this is the danger, avoidable, it is true, by proper precautions of the communication of diseases through cow's milk.

For practical use, however, cow's milk is yet superior to all other kinds of artificial nourishment. The expense (see below) is less than with prepared flours and other substitutes, the material is easily obtained and the food easily prepared.

Nourishment with condensed milk has nearly always yielded unsatisfactory results, which the peculiar composi-

tion of this article easily explains. Children fed with this suffer with exceeding frequency from acute and chronic digestive disorders, likewise from anæmia and rachitis. Fleischmann, Jacobi, Demme, Daly [1] and many others have taught this. The last-named physician, an Englishman, emphasizes the fact that some children fed with condensed milk grew fat, but were none the less weak and behind other children of the same age in power of resistance, to a very dangerous degree. This observation, that with such nourishment abundant development of adipose tissue may co-exist with weakness of the organism and delicate bones, I have myself made several times. There are but few authors, as Vogel and von Ammon, who think that good results have been achieved with condensed milk. [It is unnecessary to quote their arguments in detail.]

Monti (*Archiv für Kinderheilk.*, ii., 1, 2, p. 21), who has made numerous experiments with *Biedert's cream mixture*, sums up his judgment in the following sentences:

1. For new-born infants it is used with better success than other articles of nourishment.

2. It is not an absolute substitute for mother's milk.

3. In many cases severe diseases of the intestines were cured with it. The mortality observed during treatment is much less than with nourishment and treatment according to other methods.

4. The nutritive value of the mixture is very noticeable, since not only in well children but also in such as were ill a considerable gain in weight was observed while it was given.

5. Biedert's mixture is also to be recommended as of use during the time of weaning.

According to this it seems as though the results were most favorable with new-born infants and such children as

[1] Daly bei Fleischmann, "Ueber Ernährung und Köperwägungen der Neugebornen und Säuglinge," 1877 p 43.

suffer from weakness of digestive power, but it will be well to await further reports.

For the nourishment of children the articles prepared from flours of the grains or other vegetable substances have a decidedly less value than cow's milk. In this almost all physicians of the present time agree. They absolutely reject such articles for the first 2–3 months, for the reasons already repeatedly given, and make use of the better kinds for older infants only when cow's milk does not agree with the latter or when it cannot be obtained of good quality; and this is decidedly the rational way of doing.

The general judgment passed upon flour porridge is completely adverse. Only Vogel[1] remains in its favor (whether it is the genuine flour porridge [*Mehlbrei*] or the one consisting of bread and milk [*Semmelmus*]), and recommends it for infants of four months and older.

Concerning the value of Liebig's soup, reports differ. At first it received nothing but praise; von Liebig,[2] Hecker,[3] Ferber,[4] von Pfeufer,[5] all met with very favorable results, and the last recommended it even for infants from the third day of life on. Many English and North American physicians were also inclined in its favor, but in France it met with early opposition (Guibourt, Bouley, and other). Less favorable reports came soon, not only thence, but from Germany itself; stomach and intestinal catarrh and standstill in development were often noticed. One of the reasons for this difference may assuredly be found in this: that the soup in question is sometimes properly and sometimes improperly prepared; but the essential reason is that this nourishment is not digested alike by infants in the first weeks and those in later months. If the preparation is

[1] Vogel, "Lehrbuch der Kinderkrankheiten," 1873, p. 36.
[2] von Liebig, "N. Repert. für Pharmacie,' xiv., xv.
[3] Hecker, "N. Repert. für Pharmacie," xv., 202.
[4] Ferber, *Archiv für Heilkunde*, viii., p. 267.
[5] von Pfeufer, *Bayerisches ärztliches Intelligenzblatt*, 1867, No. 31.

correct and the child over three months old, rather good results may be obtained, as I myself can confirm. Lorch[1] has recently reported very great success. He found the daily gain in weight of a child three months old:

19.6 with cow's milk,
8.3 " Nestle's flour,
26.5 " repetition of the cow's milk nourishment,
38.8 " Liebig's soup.

Nourishment with the so-called children's flours, those of Nestle, Faust-Schuster, the farine lactée of Cham, etc., has likewise furnished bad results in the first months of life. Reimer[2] examined altogether 310 children which were fed with Nestle's flour to ascertain the gain in weight;

108 children were 0– 3 months old,
112 " " 3– 6 " "
90 " " 6–12 " "

Of the first group the gain in weight was decidedly insufficient, for it was only 8–15 grms. daily, instead of 28–35 grms. The gain of the children of the second and third groups was somewhat greater, namely: 12–20 grms; but these, as well as those of the first group, all except three, became rachitic—a very sad result.

How unsatisfactory nourishment with Nestle's flour, Gerber's flour, and other articles of this kind has proved, Demme has also shown. He expresses his opinion in these words: "These flours are not digested by infants before they are eight weeks old, and then easily give rise to diarrhœa. Also with children in later months the flours do not yield so good results as does cow's milk. For children in the sixth, seventh, eighth month, the articles of food under consideration may be used with cow's milk. A great number of children whose entire nourishment consists of the said articles become rachitic." Albrecht.[3]

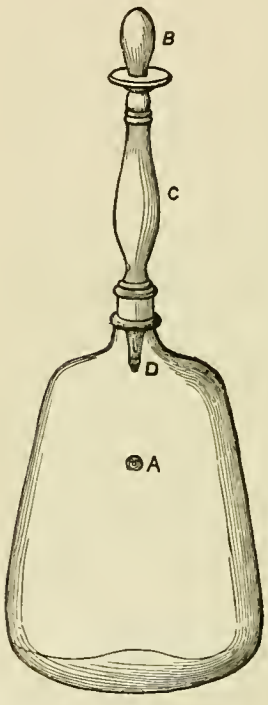
[1] Lorch, Kinderwägungen zur Bestimmung des Nährwerthes der Frauenmilch, Kuhmilch, Nestle's, Gerber's Mehl, Liebig's Suppe, etc., 1878.

[2] Reimer, Ueber Surrogate der Muttermilch, in *Petersburger med. Wochenschrift.* 1879, 50.

[3] Albrecht, Wie ernährt man ein neugebornes Kind? 1879.

According to the foregoing, we must always place our chief dependence upon cow's milk for artificial nourishment. Experience has recognized that it is wrong to feed infants of the first ten to twelve weeks with prepared flours, Liebig's soup, or flour porridge, but that they should have diluted cow's milk or cow's milk with the addition of thin barley broth, or, in case neither agrees with them, the cream mixture; that also for children from the tenth or twelfth week to the ninth month, cow's milk properly prepared is the best artificial food, and that only when this fails to agree with them, or cannot be obtained of suitable quality, is Liebig's soup or any of the prepared flours to be allowed for children of nine months and over.

NOURISHMENT OF INFANTS WHO CANNOT PROPERLY PERFORM THE ART OF SUCKING.



In case of a cleft palate, the closing of the chamber of the mouth, which is necessary in order to suck properly, cannot be accomplished; and swallowing also is impeded and imperfect when there exists such a defect. Thus it happens that such children fall very much behind in nutrition, or that they even become very ill from choking, because food gets into the air tubes. For such cases we have no other recourse than with the utmost care to feed the child with a porcelain boat (so-called *Schiffchen*), or by means of the Biberon-pompes of Monchovaut or Soltmann.

The last-named utensils are also particularly suitable for feeding infants who, owing to a defect in the ligament of the tongue, an excessive cold in the head, or general weakness, are not sufficiently able to suck. The Biberon-pompe of Soltmann (see drawing on p. 96, from the *Jahrbuch für Kinderheilkunde*, 1878, p. 408) is a natural suction-pump. The front convex surface has a small opening, A, for the admittance of air; the concave surface at the back rests upon the chest of the child while it drinks. The rubber mouthpiece, B, its top perforated several times, is connected with a rubber balloon, C, which is drawn out longitudinally, and by means of a tube, is connected below with a rubber cap drawn over the neck of the bottle. This cap forms the stopple and carries a suction-tube projecting into the bottle. The lower glass end of the tube is dilated, and contains a rubber funnel with the conical part upppermost (D). A diagonal slit in the funnel transforms it into a valve. The pressure of the mother's fingers upon the balloon C, suffices to send the liquid from the bottle into the child's mouth.

NOURISHMENT OF SYPHILITIC INFANTS.

It is of the greatest importance for a child with hereditary syphilis to have its natural nourishment. That such a child be nursed by its own mother is something to be earnestly striven for. It is certain that in the somewhat rare case in which she had escaped the disease herself, she will not be infected by her syphilitic child while nursing it, while on the other hand, a wet-nurse runs the almost sure risk of infection by nursing a syphilitic child not her own. If, on account of weakness of the mother or her lack of milk, artificial nourishment must be resorted to, cow's milk should, under all circumstances, have the preference. Fournier recommended for the same purpose goats as wet-nurses (*Gazette des hôpitaux*, 1878, p. 49).

NOURISHMENT DURING TRANSITION TO SOLID FOOD.

As has repeatedly and emphatically been said, it must be accepted as a principle that children nourished in the natural way, receive nothing but the mother's milk, if the supply be sufficient, and in the time immediately after weaning nothing but cow's milk; that infants artificially nourished receive until about the same time—the first ten months at least—*nothing but the liquid food previously discussed.* In what way the diet should be conducted after this period was but briefly noticed and will now be discussed more at length. Of course the transition to solid food must not be made suddenly, but gradually. It is done by means of half-fluid nourishment. Those articles which have proved the most suitable are:

Milk soups, made of milk and wheat flour or rice; milk with *Zwieback* or white bread soaked in milk; pulverized cacao (deprived of its oil) boiled with milk; meat broth boiled with a little semolina and the yolk of an egg stirred into it; raw beef scraped fine and then pressed through a sieve; finally, also very soft-boiled eggs.

All these articles are, on account of their soft, pulpy character, very well suited for making the transition. Care must be taken that the animal substances always predominate over the vegetable. The daily quantity of flour and *Zwieback* must not be large. If used to a conspicuous extent they may even at this stage of growth give rise to disordered digestion; and, on account of the meagre quantity of lime contained in them, may cause rachitis, which so often appears directly after weaning. Food prepared from cacao deserves special recommendation. The shelled beans contain on an average:

water	proteine and theobromine	fat	carbohydrates	ash
3.25 %	14.76 %	49 %	29.34 %	3.63 %

But the flour of cacao (deprived of its oil) contains only

20–35 per cent. of fat and about $\frac{1}{6}$ more of nitrogenous substance than that from which the oil has not been removed.

Scraped raw beef [better, slightly cooked], which should be carefully prepared by the mother or nurse, is liked by children from eleven to twelve months old, and thoroughly digested by them. It is all the more valuable from the fact that it prevents diarrhœa, and in case there is no coincident stomach catarrh may even cure an existing intestinal trouble. There is probably very little danger of transmitting parasites (eggs of worms) through the meat when it is prepared at home.

NOURISHMENT OF CHILDREN FROM 2-6 YEARS OLD.

Although the digestive organs of children from two to six years old manifest a power of resistance essentially greater than do those of infants, they are still easily affected by substances not easy of digestion, particularly when the children belong to the youngest age here mentioned. This susceptibility is due to the same causes as is that of the youngest infants.[1]

[1] Age.	Grms. urine.	Grms. fæces.	Nitrogen in urine and fæces.	Corresponds to albumen.	Gain in weight.	Gain in albumen.
2 years.	641	62	6.4 grms.	41.3 grms.	5 grms.	1.
3 "	619	101	6.6 "	42.6 "	3 "	.6
5 "	729	134	8.4 "	54.2 "	5 "	.84

Age.	Albumen wasted.	Albumen stored.	Total need.	Amount really given.
2 years.	41.3	1.	42.3 grms.	47.1 grams.
3 "	42.6	.6	43.2 "	44.8 "
5 "	54.2	.84	55.0 "	63.7 "

Thus some of the albumen given is not accounted for, and cannot be explained by the losses in the perspiration, although these also have been estimated by Camerer. The children throve on the above dietary limits, which must therefore be regarded as normal.

[A scientific basis for the diet of children of this age, as for that of infants, is found in a detailed comparison of the elements of the food, with those of the excretions. Thus in order to know how much albumen is daily required in the food, we must first know how much is daily stored up in the organism, as it is evident that this quantity is the very least with which the child can get along.] The data given in the preceding note were obtained by Camerer from his three children.

[As already explained, the nitrogen obtained by chemical analysis from the urine and fæces, is known to come from the decomposition of the albumen of the food, a definite amount of nitrogen corresponding to a definite amount of albumen. This analysis shows, therefore, how much albumen has been wasted and excreted. Another part of the albumen of the food must be stored up in the body, and contribute to its daily gain in weight. By means of other calculations, not given here, it is possible to know how much of this daily gain is due to nitrogenous, *i.e.*, to albuminous material. The least amount of albuminous food required, therefore, is equal to the sum of the two kinds of albumen, that which is wasted, and that which is stored.]

The carbohydrates of the food are eliminated under the form of carbonic acid in the respiration, and of this no analyses have as yet been made. Therefore we have not a scientific basis for regulating the amount of carbohydrates in the food. But the diet of Camerer's children,[1] as given in

[1] Age.	Amount.	Albumen.	Fat.	Carbohydrates.
2 years.	1,185 grms. (2.8 lbs.)	47.1 grms.	43.3	95.9
3 "	1,203 " (2.84 lbs.)	44.8 "	41.5	102.7
5 "	1,510 " (3.5 lbs.)	63.7 "	45.8	197.3

the note, seems to have been quite satisfactory. Some other analyses are given below.[1]

In consideration of all these data, I would formulate the following standard of elementary substances for the diet of children aged from 2 to 6 years.

Age.	Albumen.	Fat.	Carbohydrates.
1½ years.	42.50 grms.	35 grms.	100 grms.
2 "	45.50 "	36 "	110 "
3 "	50.00 "	38 "	120 "
4 "	53.90 "	41.5 "	135 "
5 "	56.00 "	43 "	145 "

[1] Age,	Weight.	Food.	Proteine.	Fat.	Carbohyd.	Totals.
2¼ years.	12,200 grms. (28½ lbs.)	Milk. 700 grms. (1⅝ pints.)	31.5 grms.	27.3 grms.	26 grms.	Proteine =
		Rice. 75 grams. (2½ oz.)	5.2 "	.0 "	57 "	50.2 grms.
		Bread. 50 grms. (1⅝ oz.)	3.5 "	1. "	25 "	Fat = 36.63 grms.
		Meat. 50 grms.	9. "	.5 "	0	Carbohyd. = 108— grms.
		Broth. 175 grms.	1.0 "	.5 "	0	
		Butter. 8 grms.	.0	7.0 "	0	

The daily excretion of nitrogen in urine and fæces amounted to an average of 7.3 grms., corresponding to 47 albumen. The daily gain in weight amounted on an average to 5.3, grms., corresponding to 1.06 albumen. Total need of albumen = 48.06 grms.

2. A strong boy of 4¼ years, gaining weight normally, weighing 15,250 grms., not taking into account the water consumed.

Milk	540 grms.,	24.3 albumen,	20.5 fat,	20. carbohydrates.
White bread and Zwieback	180 "	12. "	.0 "	85. "
Butter	25 "	.0 "	23. "	.0 "
Potatoes	125 "	2.2 "	.0 "	26. "
Meat	80 "	14.0 "	.7 "	.0 "
Coffee with milk	200 "	3.2 "	2.7 "	3.2 "
Total	1,150 grms.,	55.7 albumen,	44.7 fat,	135.8 carbohydrates.

The daily average N. excretion in urine and fæces was 8.1, corresponding to 52.2 grms. albumen. The daily growth was 4 grms., corresponding to .8 albumen. Total need of albumen, therefore, 53 grms.

The number of meals should still exceed that for an adult. Most children of this age eat five or six times a day. [This is certainly unnecessary, and contrary to the American habit. Only three meals are required, so long as supper is taken at 5 or 6 P.M.; if at 7, then a light afternoon lunch may be desired, but not invariably. Similarly, children awaking at 5 or 6, and not breakfasting till 8, do better with a cup of milk and Zwieback before dressing. But by 3½–4 years, the standard should be three meals a day.]

Food must not be given which is too hard, as its mechanical irritation easily causes convulsions. Nor must it contain too much of starch, sugar, or the organic acids. Sugar given in large quantities soon changes into acid.

From these considerations, we forbid children from 2–6 years coarse bread, because sour and containing bran; further, fruit with a hard skin or not fully ripe, mushrooms or funguses of any kind, lettuce and cabbage, spinach, all sweetmeats, potatoes in any considerable quantity. To be recommended are, first of all, milk as chief article of food; then meat, eggs, butter, white bread, Zwiebach, rye bread, and rice; and for children with weakened digestion, and standing especially in need of invigoration, leguminose. The composition of the substances first named is known, and has been already discussed. With reference to the rest, I give the following short notes from König[1]:

Semmel or wheat bread contains on an average:

water	albumen	fat	sugar	other carbohydrates	cellulose	ash
38.51 %	6.82 %	.77 %	2.37 %	40.97 %	.38 %	1.18 %

Fine rye bread on an average:

water	albumen	fat	carbohydrates	cellulose	ash
40 %	6.5 %	.5 %	51 %	.35 %	1.65 %

Rice contains on an average:

	water	albumen	fat	carbodydrates	cellulose	ash
(grain)	13.23 %	7.81 %	.69 %	76.4 %	.78 %	1.09 %
				sugar and gum	starch and ash	
(flour)	14.15 %	7.43 %	.89 %	2.21 %	75.41 %	

[1] König, *loc. cit.*, vol. ii., p. 334.

Children of the age here referred to do not need great variety in their food, nor to have their palate tickled by strong condiments and spices, which are indeed positively injurious to them. So also are tea, coffee, spiced chocolate, wine, beer, and any form of alcohol, all of which unduly excite the nervous system. [These latter substances, moreover, if given in large quantities, all tend to retard growth. The idea—much more popular in Germany, it is true, than in America—that alcoholic stimulants "strengthen" children, is as injurious as it is erroneous.]

NOURISHMENT OF CHILDREN FROM 6–15 YEARS.

The digestive organs of children during this period do not differ essentially from those of adults, and it is in accordance with their greater degree of development, that their liability to disease markedly decreases.

The molecular changes in the tissues of children at this age are better known than in those younger; and the excretion of carbon in the respiration has been estimated, as well as the excretion of nitrogen in the urine.[1]

[1] A child 8–9 years excretes daily :

Urine.	With nitrogen.	Corresp. to albumen.	Fæces.	With nitrogen.	Corresp. to albumen.	Growth.	Corresp. to albumen.
1,034 grms.	6.8 grms.	44 grms.	117 grms.	1.94 grms.	12.50 grms.	4.7 grms. daily.	.94 grms.

Total daily need of albumen = { 44. / 12.50 / .94 } = 57.44 grms., containing 30.60 grms. carbon.

Total excretion of carbon . . . . . = 130.00 grms.

Carbon required in addition to that in albuminous food = 99.40 grms.

Food containing 99.40 grms. carbon = { 45 grammes fat, / 150 " carbohydrates. }

This food, therefore, must be eaten in addition to the albuminous food.

Child of 12–13 years excretes daily :

As shown by the analyses and calculations given below, a child between 8 and 9 years old requires daily:

albumen	fat	carbohydrates
57.44 grms.	45 grms.	150 grms.

A child between 12 and 13 requires daily:

albumen	fat	carbohydrates
67.56 grms.	48 grms.	245 grms.

Between 14 and 15:

albumen	fat	carbohydrates
79 grms.	48 grms.	270 grms.

[For practical use, the foregoing calculations for albumen, fat, and carbohydrates, must be adjusted to the composition of the foods which contain the elementary substances. Extensive tables of the composition of various articles of food are given by Letheby (On Food, London, 1872). From one of these tables it may be learned, that lean meat contains 19.3 per cent. of albumen, milk 4.1 per cent. To supply the 57.44 grms. of albumen required by a child of 8, will therefore be required 290 grms, or about 9 oz. of meat: or else 1,400 grms., or nearly 3 pints of milk. In the same way we shall obtain the needed 45 grms. of fat from about 2 oz.

Urine.	With nitrogen.	Corresp. to albumen.	Fæces.	With nitrogen.	Corresp. to albumen.	Growth daily.	Corresp. to albumen.
1,080 grms.	8 grms.	51.50 grms.	125 grms.	2.1 grms.	13.52 grms.	12.7 grms.	2.54 grms.

Total daily need of albumen = { 51.50 + 13.52 + 2.54 = 67.56 grms., containing 42.5 grms. carbon.

Total excretion of carbon . . . = 188.0 grms.

Amount of carbon needed beside that in albumen = 145.5 grms.

Non-nitrogenous food required for 145.5 grms. carbon = { 48 grms. fat, 245 " carbodydrates. = 293 grms.

of butter, and the 150 grms. of carbohydrates (sugar and starch), from 2 oz. of bread.[1]]

With the 11th year for boys, somewhat earlier for girls, the rate of growth begins to be accelerated :

In the	11th	year,	the	daily	growth	=	7	grammes	(105	grains)
" "	12th	"	"	"	"	=	8	"	(120	")
" "	13th	"	"	"	"	=	12.7	"	(190	")
" "	14th	"	"	"	"	=	12.6	"	(190	")
" "	15th	"	"	"	"	=	13.1	"	(196.5	")

The greater part of this increase in weight belongs to the muscular system, which increases much more than at former periods, both in mass and in working capacity. This great increase in growth, the increased need of nutritive material as the child approaches puberty, demand the greatest consideration, and if these needs are neglected, there results severe and permanent injury to the whole development of the organism. Yet the increased need has received scarcely any attention. [Empirically, however, the standard is not unfrequently attained, as shown by the notes from two orphan asylums, given in the note.[2]]

[1] These data need to be again modified practically ; because when milk and meat and bread are all eaten, as they should be, each supplies a certain amount of albumen, thus :

Meat =	19.3 % albumen
Milk =	4.1 % "
Bread =	8. 1 % "
Total	31.5 %

Similarly, some of the required fat will be found in the milk, (3.9 %) and 5.2 % of sugar. We may therefore supply a part of the albumen needed, by meat, say 5 oz., which will give 31.91 grms. of albumen. The remaining 25.53 grms. needed, may be found in 18 oz. of milk. The full daily diet will then stand as follows :

Meat	5 oz.
Milk	18 "
Butter	1½ "
Bread	8 "

[2] C. Voit took steps to gain information concerning the food in the orphan asylum in Munich, where the children from 6–15 years of age look strong and well, and found the following to be the average daily amounts of nourishing material :

79 grms. albumen, 37 grms. fat, 247 grms. carbohydrates.

According to Riedel, the girls in the Gossner House, in Berlin, aged from 6–17 years, receive daily, on an average :

74 grms. albumen, 18 grms. fat, 434 grms. carbohydrates.

I have computed the nourishment consumed in the seven days of the week by my

As regards the kind of food for children of the age now considered, experience shows that a diet rich in cellulose, starch, and sugar, is still decidedly injurious. Experience shows us further that it is absolutely necessary that a considerable percentage of the needed albumen must be obtained from animal food, meat, milk, eggs, and cheese. The orphan children in Munich, who thrive very well indeed, receive meat five times a week, each time 170 grammes; also 257 grammes of milk daily, [*i.e.*, over 5 oz. of meat and ½ pint of milk. This is much less than the amount calculated for more favored children. See page 104].

Food all or nearly all of a vegetable kind causes even in children of this age anomalies in nutrition and diminishes the power of resistance in the organism. This is often seen among children of the poor, who are obliged to sustain life on bread, potatoes, and bad coffee. Selection of animal food seems to be particularly necessary for girls approaching puberty. In this period so often appear the beginnings of chlorosis, and animal food goes far towards preventing this disease. [The ingestion of albumen favors the absorption and fixation of oxygen, hence co-operates with fresh air in the formation of the hemoglobine of the blood corpuscles.]

INSUFFICIENCY OF NOURISHMENT.

The experiments made by Chossat[1] upon doves, show that young ones but illy endure the withdrawal of nourishment. Full-grown doves, if left without food, did not die until after thirteen days; young ones starved to death when three days had elapsed. The daily loss in weight was 0.35 grammes and .081 grammes, respectively. Falck observed that young dogs which were given no food from the eighteenth hour of life on, died after only three days, while

two healthy sons, one of whom is 10½ years old, the other 14¾, and find the daily average to be:

For the one 10½ years old (25 kilo) 64.6 grms. albumen, 46 grms. fat, 206 grms. carbohyd.
" " " 14¾ " " (42 ") 83.4 " " 51 " " 301 " "

[1] Chossat: "Mémoires présentés par divers savants à l'académie royale."

an old dog lived sixty-one days.[1] The daily loss in weight was 8.57 per cent in young animals, 2.73 per cent. in those one year old, 1.77 per cent. in those three years old. Magendie saw a dog four days old die after two days of starvation, while one of six years lived until after thirty days.

Experience teaches that children also, especially in the first year, succumb to want of nourishment much more speedily than do grown people. Hippocrates knew this, for he warns earnestly against giving little children too small quantities of food, because they then easily perish. Every physician knows that young infants unable to retain their food, or such as receive too poor food, or from whom nourishment is from criminal selfishness withheld, die in a comparatively very short time, under symptoms of anæmia of the brain. This is due to the small amount of albumen and fat stored in the organism, as well as to the exceedingly rapid tissue changes taking place in young individuals.

If the food contains too little nutriment or is not sufficient in quantity, the children may not succumb so readily, but they grow weak, anæmic, and thin, and not infrequently retain this weakness throughout life, even when later they are well nourished. This is particularly the case with children who did not have sufficient milk from the nurse's breast, and who, because this person was not conscientious enough to acknowledge the falling off of the milk supply, failed to receive supplementary food.

EXCESSIVE FEEDING.

Excess of natural nourishment causes infants to vomit, or to throw up a part of the milk in small quantities. This kind of vomiting is usually of no significance. The stomach easily rids itself of what is superfluous. But excess of food, especially when not of the most digestible kind, easily causes, in both young and older children, acute disturbances, such as violent vomiting, stomach

[1] Falck: "Beiträge zur Physiologie," 1875.

and intestinal catarrh, and even convulsions—the last being very often produced by nothing but overeating. Sometimes, too, it occasions a series of chronic difficulties, chronic dyspepsia, swelling of the abdomen, cutaneous eruptions, glandular hyperplasia, scrofula. The undigested part of the food decomposes, thereby irritating the mucous membrane of the digestive tract and producing wind, while the part, too large, which goes over into the blood raises the quantity of the circulating nutritive material to an abnormal degree, and occasions eruptions on the skin. That such dyspeptic conditions, as well as cutaneous eruptions, are the result of overfeeding is shown by the fact that they very frequently disappear as soon as the quantity of food given is diminished. Physicians of ancient times, especially Rhazes, recognized that excess of nourishment [as well as insufficiency] may produce scrofula, and no modern medical man denies the ætiological significance of this circumstance.

CARE OF MOUTH AND TEETH.

A clean mouth, so essential to the mouth of every one, is doubly so for children under one year of age, because particles of food in the mouth, especially of milk, very rapidly enter into acetous fermentation, and thereby produce not only irritation of the mucous membrane but also the growth of the parasite of the thrush, the oidium albicans, which is known to thrive in acid liquids. It is certain that a very large proportion of the mouth diseases of children, and almost all cases of thrush, may be prevented by keeping the mouth sufficiently clean. For this purpose the mouth should be frequently washed out. After each meal, dip a perfectly clean piece of very soft linen into clean water and with it cleanse the tongue, gums, roof of the mouth, and the internal surface of the cheeks.

The use of sucking-bags should be energetically condemned. Organic acids form in them and fungi develop,

which have entered the mouth together with the dirt that collects on the outside of them. Besides, a healthy, well-kept child has no need of being quieted by a sucking-bag.

It is also desirable to cleanse the mouths of older children by means of rinsing them regularly every morning, and after each meal.

A clean mouth is the first condition for the preservation of the teeth. Care should be given to the teeth from the earliest years on, and they should be cleansed once a day at least, either with a piece of coarse linen, or with a brush directed in both horizontal and vertical directions, in order to remove all particles of food and the fungous elements developing in them. But this local care is not all that is necessary. In the diet every thing must be avoided which is either directly or indirectly injurious to the teeth.

Any sudden change from hot to cold drinks injures the enamel, and should be avoided. Food containing a great deal of sugar should not be taken habitually, since it is highly probable that the products of acetous fermentation work harm to the teeth. I am well aware that it is often denied that sugar injures the teeth, but must, nevertheless, hold that it does, and I believe that every practising physician will agree with me. Food poor in lime is also harmful to the teeth as well as to the whole osseous system. We have seen from the experiments of E. Voit that such food may produce rachitis, in which disease the teeth almost always have a decayed, brittle, and discolored appearance.

The care of unsound teeth belongs to dentistry, not to hygiene.

CHAPTER IV.

THE CARE OF THE SKIN.

[This begins at the birth, since the very first duty to be performed to a new-born baby is that of giving it a bath.]

The skin of a new-born infant is covered with a viscous substance, vernix caseosa, which consists of epidermic cells, fat corpuscles, and little hairs. When this is removed, the skin itself appears thinner and softer than in the grown person. Its color is reddish, partly because it is more vascular, partly because, from the thinness of the epidermis, the blood shows through more distinctly. In many new-born children, from the 2d to the 7th day, the skin is yellowish-red, even when there is no jaundice. Toward the 4th or 5th day of life, rarely earlier, more rarely as late as the second week, the skin begins to peel off, somewhat as in measles or scarlet-fever, and at the same time the little fine hairs covering the skin, and even the hairs of the head, fall out. After 7–14 days this process ends. New-born infants never perspire. As far as my own experience goes, perspiration does not occur before the end of the fourth month, and then only slightly on the forehead and head. (If children under a year perspire to a striking extent, it is always a sign of weakness, especially of rachitis.)

Immediately after birth the temperature of a child is a little higher than that of the mother, about .1° Cent.–.6° Cent. higher. In the rectum it is 37.7°–37.8°–38.1°, but under the arm only 37°–37.3°. The temperature begins to sink immediately, most noticeably after the first bath, when

it falls at least .5°, according to Barensprung[1]; .99° on an average, according to Sommer,[2] even 1.87° on an average. The latter author allows .57° for the fall of temperature through the first bath alone, and therefore 1.3° for the rest of the cooling off. It is not to be forgotten that the children observed were carefully wrapped in woollen blankets. The initial cooling off is therefore physiological. The temperature begins to rise again on the very first day. It reaches about 37.55°, and remains at this height throughout the greater part of childhood. In weak infants, the initial sinking of the temperature is greater and the standard is more slowly regained. This should be regarded, and extra care given the child.

The temperature shows a daily fluctuation in the first week of life, inasmuch as it is higher in the evening than in the morning, but the typical curve of adult life is only gradually formed. In the 7th–8th year it is clearly recognizable. Variableness of temperature is characteristic of youth, as may be proved even after the typical curve is established. Small causes often produce very considerable oscillations. [In this the baby resembles the lower warm-blooded animals, whose temperature is much more variable than that of man.]

The fact deserves special mention that the child, especially in its first years, has little power of resistance against cold. New-born mammals, when placed out of reach of the mother's warm body, soon die. The temperature of the body falls at once, and very considerably, unless the animal is protected by the mother. The temperature of a dog twenty-four hours old, which Edwards observed, and which was exposed to a temperature of 13°, fell in three hours not less than 11°; and that of another dog 18° in four hours. If the cold last but a short time, the animals may recover in a

[1] Barensprung, *Müller's Arch.*, 1851.

[2] Sommer, *Deutsche medicinische Wochenschrift*, 1880, pp. 43 *seq.*

warmer temperature; if it last long, death ensues. The case with new-born children, and to a less degree with older infants, is quite the same as with animals. The body temperature sinks in proportion to the duration and degree of the cold. Attention has already been drawn to the fact that even the short, unavoidable cooling off directly after birth, and the first warm bath, diminishes considerably the warmth of the body, but we see, particularly from the effect of cooler baths, how slight the child's power of resistance against cold really is. After baths of 25° R. (31.2° Cent.), Peters[1] found in infants several months old an average fall of temperature of .83° C. in one case, one of 1.5° C., and even after baths of 26° R. (32.5° C.) he found an average fall of .45° C. The greatest declines were observed in young and weak children, or such as were of delicate build, but the averages were always considerably larger than those found by other investigators in adults, although the baths of the latter lasted longer and had lower temperatures. The explanation is very easy. The smaller the individual, the larger the surface of the body in proportion to the weight, and thus the more extensive the cooled surface. Added to this, the heat-regulating apparatus in little children works very imperfectly. That the well nourished show a less decline in temperature than the badly nourished is accounted for by the protecting influence of the *panniculus adiposus*, or cutaneous fat.

The small power of resistance of children against cold manifests itself not only in the greater decline of their temperature after baths, but also in their greater tendency to illness and the greater frequency of death in consequence of the withdrawal of heat. If after birth or in the first days of life the body of an infant cools to some extent, a very disagreeable cold in the head is apt to be the consequence, even if no more serious illness results, as laryngitis,

[1] Peters, *Journal für Kinderheilkunde*, 1876, x., p. 326.

bronchitis or *sclerema* [induration] of the skin, and *trismus* or lockjaw. Cool bodily temperature easily causes affections of the respiratory organs in older children also. Such diseases preponderate decidedly during the winter months, and in the first cool months of spring still more, probably because the children are protected in winter, while in the spring they are more exposed to the out-of-door air.

Such diseases are still very frequently attributable to the ceremony of baptism, which in most cases is undertaken in the first weeks, even in the first days of life, and usually takes place not in the house, but in church, whither the children ride or are carried, sometimes a great distance. It was related in the historical part of the present work that in earlier times the danger of a church baptism to the child's health was recognized. It is also known that the greater mortality of infants in Catholic countries is partly due to colds taken by children during the premature baptism in churches, where it is almost always very chilly. Even the custom of taking new-born children to the record office is liable to bring on colds and their consequent dangers. That this is true in France is most emphatically stated by Milne-Edwards and Villermé.[1] There the law prescribed that children should be presented to the mayor for register within twenty-four hours after birth. It has been proved that the proportion of deaths in the first month of life was much greater in winter and in the northern districts than in summer and in the south; and the reason has been plausibly found in the prevalence of this custom.

[Fortunately in America, no one is obliged to contend with the organized stupidity of either church or state in such a matter as this. One might imagine that the instinct of mothers would have sufficed to resist so absurd a custom, but it seems it has not.] The bad influence of cold is ob-

[1] Milne-Edwards et Villermé: "De l'influence de la température sur la mortalité des enfants nouveau-Nés." Mem. de la société d'histoire naturelle de Paris, v., p. 61.

served on a large scale in foundling hospitals, where the unfortunate little ones often perish from insufficient clothing. The power of resistance of the organism gradually increases with advancing years, and children of eleven or twelve often endure a winter cold better than adults.

Little definite is known of the exact effect of heat upon young children, especially those under a year old. Yet daily observation sufficiently testifies to its injuriousness, especially to the liability of diarrhœa and cholera infantum to develop under its influence.

Excessively hot baths are said to have occasionally caused lockjaw, and even an epidemic of such disease is recorded occurring in the practice of a midwife.[1] Bohn thinks pemphigus may be caused by warm baths. Certain it is that their continued use renders children languid and pale, and inclines them to perspire and take cold.

The first bath should have a temperature of 38° Cent. This is a little cooler than the amniotic fluid in which the baby has hitherto been plunged, but it must become accustomed to cooler surroundings. And years of experience proved long ago the degree given to be the proper one. The exact measurement of the temperature of the bath with a good thermometer must be strictly required, and it is the physician's duty to keep a sharp watch over midwives and nurses in this particular, as these persons are too much accustomed to measure the bath-water according to the sense of feeling. A bath which is slightly too cool, as well as one too warm—that is, exceeding the temperature of the amniotic fluid may harm the child. If the child is feeble we should order a somewhat warmer bath than usual.

Even a bath of 35° C. results, as we saw, in a slight fall of temperature of .57° C. on an average.[2] Therefore it should not be longer in duration than necessary for cleans-

[1] Bohn, *Jahrbuch für Kinderheilkunde*, ix., p. 306.

[2] Sommer, *Deutsche medicinische Wochenschrift*, 1880, pp. 43 *seq.*

ing the surface of the body. Five minutes suffice, according to experience, if assistance is at hand, and the midwife uses a sponge. The latter must be *clean*, *soft*, and *fine*, in order not to injure the skin. A thorough removal of the *vernix caseosa* cannot be accomplished in one sitting, and there is therefore no excuse for the pedantic course taken by many midwives, who do not end the bath in less than fifteen minutes.

The danger of too great cooling off also dictates that the new-born child be quickly wrapped in a warmed blanket, as soon as the bath is over, and carefully dried.

During the first year, at least, a bath should be given each day, unless it does not agree with the child. There are cases in which daily baths, in spite of the greatest precaution and the proper choice of temperature, make the infants weak, languid, and flabby. Frequently this is to be attributed to a constitution delicate from the beginning, but sometimes the cause is not to be found. The fact, however, remains, because, after putting a stop to the daily baths, the children begin to be stronger and to thrive better.

As age increases, the bath temperature should only be diminished with great slowness. At the end of the first year it must not be below 32.5° C., and at the end of the second not below 30° C. It is entirely unintelligible to me how Biedert could fix the warmth of a bath given directly after birth at 26–28° R., after the elapse of six months at 24° R., at the end of the first year at 23° R. Every one of us doubtless pursues the principle of inuring the child to cold, but not all in so vigorous a way that it may easily prove injurious. After the elapse of the first year, it is well to bathe children every other day. For older ones, unless they are to be more than ordinarily toughened, all that is necessary is a tepid bath at least once a week, to be followed by cold water poured over the whole body. During the summer,

fresh- or salt-water baths in the open air may take the place of tub baths. According to experience, even children of three or four years may bathe in the sea, provided only that they are healthy and the water is not below 21°–22° C. On the other hand, children under seven years of age should not bathe in lake or river.

[To any one who has become accustomed to look upon the morning bath as an institution at least as indispensable as breakfast, "it is entirely unintelligible" that a tepid bath once a week should be considered sufficient. The author goes on to speak of the "rich returns yielded, in the case of older children, by the daily washing of head, neck, and chest"! Why the rest of the body is to be exempt he does not explain. On the score of simple cleanliness alone the daily bath is essential to both child and adult. But, beyond this, the cold or cool bath is the most invigorating tonic to the nervous system and digestion that can be procured. It should not be below 80° Fah. for children under six months, but, between six months and two or three years, should be at 70° Fah., and below that for older children who are seen to react well. The only permanent exception is in the case of children affected with chronic nasal or pharyngeal catarrh, for whom the bath should be kept at 80°, or cold sponging substituted. It is essential that a cold bath be brief, not exceeding the time necessary for a single plunge, thus from one half to one minute. The room in which it is taken should be warm. No cold bath-room should be tolerated in any decent house.

Of course, if, for any reason, a child does not react well, seems either chilly or languid after a bath, the above rules must be modified. But the whole body must, in any case, be sponged every day, and no warm bath must be substituted.]

Local washing, in addition to the baths, is indispensable. The new-born child and the infant should be washed with

tepid water on all places where the vernix caseosa or other uncleanness appears, as in the armpit, groin, under the knee, the buttocks, the sexual parts, and the head. This careful cleansing is very necessary, because the remnants of uncleanness decompose and give rise to chafe, intertrigo, eczema, etc. The subject of keeping the head clean deserves special consideration. In young infants, in the region of the anterior fontanelle, a yellowish-gray layer of scales appears, the so-called "gneiss," consisting of epidermic cells and sebaceous secretion, together with particles of dirt. If this is not regularly removed, pustules very often come on the skin of the head, and their contents mix with the scaly coating to form an offensive scab. Beneath this, suppuration takes place, and, having no outlet, frequently works its way for some distance along the scalp. To avoid these irridents the nurse must discard the traditional prejudice which insists that the scab must be retained, but clean the head regularly and sufficiently, removing, with a flannel cloth, all the scales which again form, first applying either olive oil or soapsuds to soften them, if necessary.

TREATMENT OF THE NAVEL.

The navel of the new-born child must be most carefully attended to; because it is for some time a very vulnerable part of the body, from which many diseases may have their origin. [These diseases are nearly all infectious, and excited by specific germs which obtain entrance to the body through the navel wound.] A special and especially dangerous form of erysipelas, inflammation of the umbilical artery or vein, lockjaw, or the tetanus of the new-born, are the varying results from such infection; or, on the other hand, the bowel may protrude through the gap in the abdominal wall existing at the umbilical ring (umbilical hernia or rupture); or serious and even fatal hemorrhage may take place from the stump of the cord. [This hemor-

rhage is often accompanied by internal capillary hemorrhages into lungs, liver, stomach, and other organs,—all depending on a fatty degeneration of small blood-vessels.[1]]

The details of the fall of the cord are as follows:[2]

As soon as the umbilical cord has been tied, it begins to dry,—first at the point of ligature, and then gradually nearer to the abdominal wall. The desiccating cord shrinks and flattens; the color changes at first to blue, then to a dark bluish-gray, finally to black. On the day before complete desiccation, rarely afterwards, there appears near the abdominal wall a line of demarcation only two mm. broad, which displays a very slight degree of inflammatory redness. The cord grows weaker and weaker, soon hanging only by the vein, and on the fourth or fifth day, seldom later, it drops off. It may remain up to the tenth and even to the thirteenth day (Löwensohn).

After the falling off, we see a sore surface upon which granulations rapidly appear and a scar as rapidly is formed. In case things take their physiological course, the healing is complete abont 5, 6 or 8, days after the cord falls off; but the physiological course is frequently disturbed through local irritation and contact with infectious matters, which may exist on the finger of the nurse, in unclean pieces of bandage, in the bath water, bath sponge, or air of the sick-room. For some time after complete healing, the navel is elastic and protrudes when the child cries or coughs.

In considering the treatment of the navel, we must first speak of the ligature. As a rule, that is when the child is a strong one, this should not be undertaken until after pulsation in the umbilical cord has ceased. Many physicians advise that it be done as soon as the new-born infant has cried out lustily several times, because they are of opinion

[1] See Buhl, Acute Fatty Degeneration of New-born; also Mary Putnam Jacobi, *ibid.*, *Am. Journ. Obstet.*—Ed.

[2] See Löwensohn, Process des Abfallens der Nabelschnur, Jahresbericht des Moskauer Findelhauses, 1871.

that then the circulation of blood within the vessels of the navel can no longer be of any influence.[1] It is not proven that too early ligature promotes umbilical hemorrhage; indeed, two cases of Grandidier show that hemorrhage in the severest form may occur even when the cord was tied very late, after pulsation in it had altogether ceased. The statement is also not true that too early ligature gives rise to *scleroderma*.[2] But it cannot be doubted that ligature before the cessation of pulsation may cause passive congestion of the lungs; and it seems also confirmed that children in whom the cord was tied late show a less initial decline in weight than others. In Hähner's child, for instance, where the cord was tied late, the total loss of weight in the first three days was only 145 grammes[3] (5 oz.); of 28 new-born children which Lorch observed, the only one which showed no loss of weight was the one where the cord was not cut and tied until 15 minutes after birth.[4]

The advantage in delaying to cut the cord as long as possible, is that the blood contained in the placenta may continue to be sent into the child's body, so long as the circulation in the placenta continues. [When the after-birth (placenta) is once separated from the uterus, or sufficiently so to arrest its circulation, then of course no more blood can be sent through the cord to the child. The amount of blood which may be preserved to the child by delaying ligature of the cord has been estimated at from 60 to 120 grammes[5]].

In all civilized nations the tying is accomplished in accordance with the old method given by Soranus and always retained since his date. A double ligature is applied of a clean

[1] Jacobi, *loc. cit.*, p. 323.

[2] Hennig, Verhärtung des Zellgewebes, Gerhardt's "Handbuch," ii., p. 156.

[3] *Jahrb. für Kinderheilkunde.*, xv., 1, p. 23. The average loss in weight, as mentioned above, p. 42, is 220-330 grms. (8 to 11 oz.).

[4] Kinderwägungen, etc. Dissert., 1878.

[5] See Schücking, *Berliner klin. Wochenschr.*, 1877, 1, 2.

linen tape, not so narrow as to cut through, nor so thick or wide as to prevent the entire compression of, the vessels. The seat of the first ligature should be about 6 cm. or the breadth of three fingers, distant from the child. A second ligature should be applied a few centimetres nearer the placenta than the first. At the middle point between the two ligatures the umbilical cord is cut through. The scissors and band should both be disinfected before use. A very rude way of separation is still practised by the wild tribes of South America and Australia, where the mothers tear or even bite the cord in two and do not tie it at all. Other nations use sharp stones, shells, wooden knives; in others we find the method of twisting the cord instead of tying it; in others, that of scattering over the end remaining next to the child after the separation a powder which causes the blood to cease flowing.

The further treatment of the navel consists in the care of the remnant of the umbilical cord. In consideration of the great dangers which threaten the child immediately after the falling off of the cord, it is important to ask under what circumstances the cord may suppurate, instead of desiccating, as is normal; and whether, therefore, it is necessary to apply an antiseptic bandage. It depends solely upon external circumstances, whether the remainder of the umbilical cord desiccates or whether it decays. If the conditions essential to its drying are wanting, suppuration sets in, and with it of course the danger of septic infection. The desiccation is accomplished most rapidly and surely when the air is dry and warm. [It is in moist tropical climates that serious diseases of the navel are most common.]

Dohrn advised applying an antiseptic dressing, to be left in place for a week. But this is objectionable, as during that week the child could not be bathed.[1] It is better to keep to the old methods of treating the navel, but using

[1] *Centralblatt für Gynäk.*, 1880, 14.

great care in the cleanliness of the hands of the nurse or midwife, or whoever touches or attends to the umbilical wound, as soon as the ligature has been applied and the cord cut.

The midwife should wrap the remnant of the cord loosely in a piece of fine old linen which is absolutely clean and has been disinfected, and lay the whole carefully upon the left side of the abdomen; then cover with a broad piece of clean linen or, still better, with salicylated cotton; then, by passing a linen band free from folds and fully as broad as the hand twice around the body, so fasten the whole that no slipping of the cord to and fro is possible, at the same time avoiding carefully all pressure which might impede respiration. A thick bandage is not suitable, because it would shut out the air, while it is really desirable that this should have access to the wound, as it promotes desiccation. Oiled linen, so frequently employed for wrapping up the remnant of the cord, is also unsuitable. It keeps dampness away, it is true, but prevents the air from changing.

The bandage just described should be renewed once a day, best after the morning bath. Loosen the old one, dry the region of the navel with a soft cloth, cover the cord with Fehling's salicylic acid starch powder,[1] and apply a new bandage, observing all the while the same care as before. After the cord has fallen off, cover the sore place left with a linen cloth saturated with carbolized oil (3 : 100); do this twice a day until it has healed. Such a bandage is the best means of preventing infection of the umbilical wound by germs from the air.

After the wound has healed, the bandage should still be kept on for five or six weeks, in order to prevent the protrusion of the bowel at the weak spot, and the formation of hernia.

HAIR AND NAILS.

[These structures are physiologically closely analogous, both being modifications of the epidermis, or outer layer of

[1] Compare Sänger in *Centralblatt für Gynäkologie*, 1880, p. 446.

cells of the skin.] Frequent cutting considerably promotes the growth of both hair and nails, and this is always more rapid in children than in adults. It is to be remembered that both hair and nails contain a large amount of albumen, [also iron in the hair,] and that this is withdrawn from the nutritive store of the body during the process of growth. When the hair is cut once a month, there is a loss of seventy grammes of albumen a year.[1] It is therefore undesirable to cut hair any oftener than can be helped.

CLOTHING OF THE CHILD.

In the adult, more than three fourths of all the heat produced in the body is given off from the surface of the skin through radiation, conduction, and evaporation of water. In children the percentage of heat lost through the skin is probably still greater, because in them the surface of the body in proportion to its length is larger. Up to the present time, exact measurements on this point are wanting. Clothing has an effect upon all the three ways of giving off heat.[2] Radiation is checked because the heat rays from the skin first strike the clothing, thus remaining for a time in closest proximity to the body, and contributing to warm the atmospheric layer which immediately envelops it; conduction is diminished because the heat, in consequence of the clothing on the body, has a longer way to go in passing from the skin to the outer air; and although the giving off of heat through the evaporation of water is increased rather than diminished by the clothing, it is certainly much more equable.

A very important function of clothing is to so regulate the movement of the air streaming to and from the surface of the skin that the person remains unconscious of any such movement. This is the case when the air does not move

[1] Moleschott, Untersuch. zur Naturlehre des Menschen und der Thiere, xii., p. 187.

[2] Compare Pettenkofer, Ueber die Function des Kleider, *Zeitschrift für Biologie*, 1865, i., 180. Popper, *Oesterreichsche Zeitschrift für praktische Heilkunde*, 1872, xviii., 15.

faster than 50 centimetres in a second. The meshes and pores of the clothing should also retard the exchange of the warm air surrounding the body with the outer atmosphere. Complete cessation of the exchange is not to be desired, because gases proceed from the surface of the body which should be displaced.

This double function, of protecting the body from excessive or irregular emission of heat, and of regulating the current of air to and from the body, is performed by the clothing in different degrees according to the material, form and cut.

Of all stuffs, wool has the least heat-radiating capacity, as the experiments of Coulier,[1] Hammond[2] and Krieger[3] have shown. In general, however, the different materials do not display very great difference in this respect; for setting down the radiating capacity of wool at 100, that of cotton is 101, of linen 102, and of silk 102.5. Also with regard to absorption of the visible heat rays of the sun, the different materials are much alike, especially wool, linen, and cotton, which are of the most importance for us. But the color of the goods has a special effect upon absorption. According to the investigations of Pettenkofer, the following are the correct proportional figures for heat absorption: for white, 100; dark yellow, 140; light green, 155; Turkish red, 165; dark green, 168; light blue, 198; black, 208. White clothing, therefore, protects far more against the sun's heat than blue or black, as was recognized long ago through daily experience.

Silk and cotton clothes possess the greatest heat-conducting capacity, those of linen less, of wool still less. The first check conduction to the extent of 3–5 per cent., but linen 5–9 per cent., and flannel and thick wool, 14–31 per cent.

[1] Coulier, *Oesterlen's Zeitschrift für Hygiene und Medicinische Statistik*, 1860, i., 200.

[2] Hammond, A Treatise on hygiene, etc., 1863.

[3] Krieger, *Zeitschrift für Biologie*, 1869, v., 517.

But it is less the material itself than its form—more properly, the space it occupies and its porosity, which affect the conduction of heat; for fresh flannel warms more than that which has been washed and is therefore shrunken, and cotton which has been pressed together does not warm so much as that which is fresh and loose. If the substance itself were of so great importance when considering the conduction of heat, a double layer of it would not have so different effects according as it is drawn tight or allowed to lie loose. And this is in fact the case; for flannel, the hindrance to the conduction of heat is only 14 per cent. when it is drawn tight, and when it lies loose the hindrance is 29 per cent.

The penetrability of stuffs for air, is greatest in flannel and woollen, least in the so-called water-proof materials. According to Pettenkofer,[1]

4.14	litres	of	air	passes	through	silk,
6.03	"	"	"	"	"	linen,
10.41	"	"	"	"	"	flannel

in one minute, under pressure of a water column of 4.5 cm. over a surface of 1 cm. in diameter.

Flannel, therefore, permits much better ventilation of the body than linen. Wet stuffs, in which water fills the pores instead of air, are impervious to air.

The hygroscopic behavior of clothing material is of great sanitary importance. All kinds imbibe a certain quantity of moisture from the atmosphere as long as they themselves have a low degree of dampness, and give off moisture as soon as they have reached a high degree of dampness. According to the determinations of Pettenkofer, this property differs according to the nature of the stuff. Flannel is able to take up much more moisture than linen, while linen, on the other hand, loses its moisture much more rapidly than flannel; in

[1] Pettenkofer, Ueber die Function der Kleider, *Zeitschrift für Biologie*, 1865, i., 180; also in "Beziehungen der Luft zur Kleidung," 1872, p. 22.

a word, dries much faster. The slow drying of flannel which has become damp and the rapid drying of damp linen is of great hygienic importance, inasmuch as warmth is associated with the drying.

Stuffs also absorb gases, though to very different extents. According to Stark,[1] this occurs in a greater degree in stuffs made of animal substances, as flannel, woollens, silk, than in those made of vegetable substances. It appears also that dark and rough stuffs absorb more gases and retain bad odors longer than light ones.

It is an important fact that clothing may become the cause of disease. This may occur when the form is a wrong one, the cut unsuitable; when the clothes are put on in such a way as to exert local pressure, check the circulation, respiration, perspiration; or diseases may result from poisonous substances which had been taken up during the fabrication, as arsenic, aniline, lead. Finally, clothing often absorbs infectious material, as that of scarlet-fever, measles, diphtheritis, cholera.

Let us now consider in detail children's clothing. The stuffs principally in use are linen, flannel, wool, and cotton, whose chief properties have just been discussed. Clothing should be made of these materials, with special consideration for the constitution, sex, and age of the child, for its power of heat regulation, for the nature of its skin, for the liberty of its movements. Only by such minute forethought can clothing be rendered hygienic.

The clothing of the new-born child and of the infant should be properly warm, should be dry, must not bind, must not irritate the delicate skin, nor interfere with breathing, circulation, or movements[2]; must be easily put on and taken off, and fastened with buttons and strings, not

[1] Philos. Trans., 1833, p. 305.

[2] Singular superstitions in this respect have widely prevailed and are of great antiquity. It has been supposed that a child's limbs must be tightly bound, lest it should dislocate or break them.—ED.

with pins. In the first weeks it best consists of a soft linen shirt long enough to cover the abdominal region [preferably a knitted shirt]; a triangular linen diaper for the loins, sexual parts, and thighs; little flannel jacket with sleeves; [a long flannel skirt with a straight, sleeveless waist, which can pass round the trunk under the arms and be fastened with safety-pins. The skirt should be long enough to pass below the feet of the baby, and then be doubled up and fastened with a pin at the level of the thighs. Under the waist of this first skirt or "barrow," as it has been called, should pass a flannel band snugly round the body and over the linen dressing of the navel. A cambric night-dress, high in the neck and with sleeves, should be worn over the flannel skirt. The feet should be clothed in knitted socks. No head covering is required in the house. When the child is taken out-of-doors it should wear a cap, well over the ears, of linen, silk, or wool. At the end of the first month the straight cambric night-dress may be exchanged for a yoked dress.] A white, long petticoat, with narrow tape shoulder-straps, is also then put on between the flannel skirt and the cambric dress. These long clothes are worn until the age of six months, when the child should begin to make efforts to creep or stand, and the clothes should therefore be shortened, and soft kid shoes replace the knitted socks. Drawers may then be worn over the diaper; but the latter is usually required for a year.

It is scarcely necessary to point out that the utmost cleanliness is necessary for the child's clothing. No wet, soiled diapers should be permitted, nor should diapers once wet with urine be worn again after simple drying, but they must always be washed. A pail of water should stand in a closet of the nursery, and into this the diaper should be thrown as soon as removed. It sometimes is sufficient that the diaper be thus rinsed, then hung up to dry before the nursery fire, without going through the laundry, provided

the dried residue of urine is thereby removed, instead of remaining to irritate the baby's delicate skin. No "drying" powders take the place of careful cleanliness of the baby's thighs as a means of preventing "chafing" (intertrigo, erythema, even eczema, all pass under this name). But after the washing it is desirable to powder the groins with salicylated starch or French chalk, the former being probably the best. Severe intertrigo, to which weakly infants are especially exposed, necessitates more than hygienic care; it needs therapeutic treatment, with local applications of astringent and antiseptic ointments.

[In providing the wardrobe of a new-born baby, in a private family, the following list of articles would be required: 100 diapers; 4 flannel bands; 6 knitted wool-shirts; 4 straight flannel shirts; 8 cambric dresses for first month, used as night-gowns in second; 8 yoked and longer cambric dresses; 8 cambric skirts; 2 pair first socks, 2 pair larger size; 2 thin flannel jackets; 1 cap; 1 long wadded coat; 1 knitted blanket for baby carriage.]

At the beginning of the fourth year a difference may be established between the clothing of boys and girls. It may then suitably be made similar to that of grown persons in material, form, and cut. [This habit has been fortunately changed in America, where the form and cut, and to a considerable extent even the material, are now delicately fashioned and contrived expressly for children. Their charming modern costumes are in refreshing contrast to the stiff and clumsy dress of former generations. Prettiness, however, though really desirable, for in every thing the child should be the poem of the household, should not lead to a disregard of the] circumstances of climate and season, as so often happens. Children should be neither immoderately exposed with the false idea of hardening, nor rendered delicate by hot-house treatment; both courses work harm. Fashion and want of common-sense sin to a wide extent in both

directions. It is wrong to let children go in our climate with the arms, calves of the legs, and upper part of the chest bare. On so large a surface the cooling off is so great that harm might easily result. But too warm clothing is also wrong, especially when applied to the neck and head.

SINGLE GARMENTS FOR CHILDREN FROM THE FOURTH YEAR ON.

1. The Shirt.—The properties of wool mentioned above compel us to recognize the flannel shirt as hygienically the best one for children of four years and more, who are lively in their movements and perspire more freely. It is a prejudice of the Germans to think flannel next to the bare skin weakening, when in truth it regulates so well the ventilation of the surface of the body and evaporation from it. True, such shirts are at first uncomfortable for children with their delicate skin; they also shrink in the washing and are expensive, but they afford important protection and prevent numerous diseases, particularly of the respiratory organs and rheumatism, and therefore deserve to come into much more extensive use. For children of a delicate constitution, with inclination to throat and chest catarrhs, they are indispensable, for in such cases without them it is scarcely possible to strengthen the constitution. I have seen this in my own eldest son. He suffered repeatedly, in his second and third year, from laryngitis and bronchitis, which a slight change of temperature sufficed to produce. From the day when a flannel shirt was put on and the linen one taken off he remained so perfectly free from those diseases and other affections of the respiratory organs that he is now large and strong and has scarcely coughed once since the reform. [American customs have adopted the flannel shirt as a matter of course.]

Besides flannel, the *vigogne* of Herbert is a very good shirt material. It is a texture made of nearly equal quanti-

ties of wool and cotton, which is lighter and softer than flannel, does not scratch so, is easily washed, and does not shrink.

As good cotton stuffs are always slower in giving off moisture than linen, they are preferable as material for shirts. Linen, hygienically considered, thus takes the lowest place. The only advantage it has over flannel is that of being more easily cleaned. Under all circumstances, no matter of what it is made, the shirt must be changed at evening for a clean one, while the day shirt is allowed to air thoroughly overnight.

2. Trousers.—They should be loose at the knee and hips, and held with suspenders. Straps press upon the abdominal organs, dispose to abdominal ruptures, and cause the abdomen to perspire. The suspenders should not be too narrow, nor have a cross-piece in front, as the latter interferes with the action of the chest, besides doing no good whatever. [For boys under ten it is much better to fasten the trousers to the shirts or blouses habitually worn under the jacket.]

Drawers are much to be recommended on account of keeping the body clean under the trousers. For summer they should be of light cotton material, for winter of flannel.

3. Vest and Jacket or Coat.—These should set so loosely that the movement of the arms, circulation of the blood (especially in the vessels of the arms), and breathing are not interfered with. A blouse is excellent for summer wear, and for winter also, when made of suitable material. It allows the greatest freedom of movement and respiration, and affords sufficiently the protection of a coat.

4. The head-covering should keep off cold, wet, the sun's rays, and bright light; should not be too warm, nor tight enough to shut out the air, and should not press too much. If these conditions are fulfilled, it is hygienically correct. A

light, unwadded, cloth cap is best, provided with a sufficiently high and broad front-piece of leather. To expose the bare heads of children to the hot sun is dangerous on account of the possibility of congestion of the brain.

5. The NECK-COVERING should never press the blood-vessels, whether the head is held erect or bent over, and, as already said, should not give too much warmth. Great attention should be paid to the first requirement, particularly if the child goes to school, since the position taken in writing is alone sufficient to hamper circulation in the blood-vessels of the head and neck. With the rapid growth of children, shirt-collars easily become too tight; this should be allowed for when they are cut [or better, new ones provided as needed]. Cravats should be discarded altogether, since they are so apt to disturb the circulation while writing.

6. STOCKINGS AND SHOES.—Stockings are to protect the feet and legs from cold, promote cleanliness of the feet, and prevent the shoes from rubbing and pressing against the latter. Stockings knit or woven in wool or Herbert's material doubtless answer the purpose. Such stockings are warmer than cotton ones, which much more readily admit of chilblains or entire freezing of toes or heels. Moreover, woollen ones transmit the gases of perspiration better, which is important for the feet, and more completely absorb the perspiration; [still, cotton stockings must be worn in summer]. For the latter reason the stockings should be changed frequently, and washed carefully. Stockings when wet should be removed immediately and replaced by dry ones. Pettenkofer[1] has made the calculation that when only 1½ ounces of wool in the stockings is wet through, the evaporation requires enough heat to raise half a pound of water from 0° to the boiling point, or to melt half a pound of ice. He adds: "Indifferent as many persons are to wet feet, they would object very much if their feet were called into

[1] *Zeitschrift für Biolog.*, 1865, p. 193.

use for heating a quantity of water equivalent to the cold of evaporation, or to melt an equivalent quantity of ice." These words deserve especial notice in the hygiene of the child.

The shoes should receive the most careful attention, those of children even more than those of adults, because the foot of a child is much more delicate and yielding, and in the process of growth is constantly changing form, and because any distortion of the feet produced by mistakes in clothing them during the early years is, as a rule, incurable.

The shoes may be too large and rub against the feet, or too small and pinch; they may influence the perspiration, and disturb growth; they may be too short, likewise hindering the growth of the toes, and forcing them into an unnatural, curved position, which is aggravated in descending an inclined plane (stairs). A badly shaped shoe may force the edge of the great toe downwards, forming the flat foot. The same effect is often produced by wearing shoes which are down on one side. It not seldom happens that when the sole is too narrow the pressure of the upper part pushes the great toe from the normal position towards the outer side, and the little toe towards the median line under the fourth toe. At the same time the great toe-nail very easily grows in, and the ball of the foot, side of the little toe, and the toe-joints become callous. Too high heels, besides constantly pressing the fore part of the foot against the shoe, produce an abnormal position of the whole body, including the vertebral column and the pelvis.

The clothing of the feet is hygienically correct when it secures them from wet and cold, protects the soles from the roughness of the ground; neither obstructs the circulation nor the perspiration, does not press on the nerves, and does not disturb the foot in the changes it makes in walking. The foot when set upon the ground is flatter than when held suspended, and at the same time longer (by about $\frac{1}{12}$–$\frac{1}{10}$ of an inch), and wider (by $\frac{1}{10}$–$\frac{1}{9}$).

A shoe to be properly made should be fashioned after the shape of the sole of the foot. The latter is correct only when the line drawn parallel with the fore part of the median edge of the sole, at a distance from it equal to one half the width of the great toe, would, if prolonged at the back, pass through the middle point of the heel. In order to make the sole fit exactly, it is necessary to draw the outlines of both naked feet when set down under the weight of the body. Starcke[1] recommends that for this purpose the person stand on a table with the foot to be measured firmly set upon a sheet of paper. A second person should then draw the outline with an Erhardt measuring apparatus, or with a lead-pencil split in two.

To determine the length it is not sufficient to measure from the heel to the end of the great toe, because in walking the foot lengthens. The height of the great toe should be added to the length of the sole, especially during the period of growth.

The size of the instep should be taken with a tape measure drawn rather tight. A shoe should never be loose over the instep.

The size of the ankles and the distance of the ankle-bones from the floor should be ascertained.

The last should be made after these different measurements and a pair of worn-out shoes.

A pair of shoes should never be made for both feet after the same measurement, since the two feet are never exactly alike. Neither should a shoe or boot be worn on the right and left foot indifferently.

It cannot be affirmed that the clothing of young girls in our country is in and of itself unsuitable, from the hygienic point of view, but in many classes of the population, it has undoubtedly become so through ignorance, vanity, and fashion. In the case of numbers of young girls it very im-

[1] Der naturgemässe, Stiefel, 1880.

perfectly fulfils its true purpose—the regulation of the body's exchange of heat, at least throughout the greatest part of the year; and it very often impedes the respiration, circulation, and normal development of the organism or of special parts of the same. This is all the more important to consider, because girls are more sensitive than boys, react more violently under differences of temperature, and because the organs affected in their development are principally those which are of eminent significance for the physiological mission of woman. For these reasons the question of the clothing of young girls should be taken very seriously.

In our climate drawers should by all means be worn by rich and poor, and they should be so made that they really serve to warm the body. They should therefore reach far down, fitting closely around the legs below the knees, and in winter should be made of vigogne or flannel, trimmed perhaps with a linen edge, and in summer of linen or cotton.

Further it is necessary that the dress be made high-necked, that it does not leave the upper part of the chest bare, as is so often the case. If it is to fulfil its purpose, it should not end at the knee, but reach at least nearly to the ankles and should have sleeves which cover the arm nearly to the wrist. [It is certainly not necessary, where suitable stockings and drawers are worn, to disfigure a little girl by a dress extending to the ankles. In winter, when out-of-doors, the legs should be protected by worsted or cloth gaiters; in summer no special protection is required.]

The corset should never be worn in youth. At the time when young girls usually begin to wear it, at about the twelfth or thirteenth year, it may very much obstruct their development. In this period the chest begins to grow rapidly and the thorax should undergo no pressure. The corset presses upon the abdominal organs, impedes their normal development, and disturbs the circulation, which is particularly dangerous at the time of approaching puberty.

Throughout childhood a waist should be worn instead of a corset. It should be knit of cotton and seamed lengthwise. It is then elastic, gives support, does not disturb the perspiration or breathing, and is very good to button the drawers and skirts to. [Mothers anxious to "form the figure" of the daughters should be told that they are trying to "atrophy" it and all the vital organs.]

The stockings of girls should be woollen through all of the cool part of the year at least, for the reasons which have been repeatedly given. The garters should be broad and buttoned on. If tight around the leg they impede the circulation and give rise to varicose veins.

The shoes of young girls need constant attention. All the details spoken of above should be considered; especially it should be seen to that the soles are of sufficient thickness, the uppers soft, and the heels broad and low.

[It seems difficult to adequately impress the public, or even family physicians, with the full extent of the evil done by errors in the clothing of young girls. Our author says nothing about the weight of clothing, the length of skirts, the innumerable details, which seem to be so many contrivances to impede freedom of movement, and to really cripple the activity of a young girl into the comparative immobility of middle age. Modern ingenuity is just beginning to solve the problem of reconciling the grace requisite for a girl's dress, with the freedom necessary for a boy. The problem is not too difficult, if its importance once be perceived.]

CHAPTER V.

HYGIENE OF THE DWELLING.

Stress has repeatedly been laid upon the great importance of the construction of the dwelling for the health of children. My present object is to discuss the requirements which hygiene must impose upon apartments arranged for the young.

The salubrity of a dwelling is affected by the purity or impurity of the air within, by the amount of moisture contained in it, its temperature, the measure and manner in which it is provided with natural light, by the ground on which the house stands, by the presence or absence of unhealthful conditions in the neighborhood.

Concerning the purity or impurity of the in-door air, it depends:

1. Upon the measure of contamination through the breath of the inmates, through artificial illumination, emanations from the kitchen, privies, through the dust from the furniture, clothing, etc.

2. Upon the nature and quantity of the air surrounding the house.

3. Upon the amount of ventilation.

4. Upon the purifying power of the sun's rays.

The carbonic-acid gas is first to be considered. This is most abundant in the basement, probably because of its connection with the ground air[1] [partly because this gas, being heavier than air, always tends to sink to the lowest

[1] Forster, *Zeitschr. für Biol.*, xi., p. 372.

place]. There is already, therefore, reason to place children's sleeping-rooms in the upper stories,—for here the carbonic-acid gas is scarcely more abundant than in the outer air. Children, relatively to adults, eliminate more carbonic acid, so that the thorough ventilation of their bedrooms is of special importance.

The quantity of organic substance existing in the air within doors, is in general parallel with the quantity of carbonic acid, since it comes for the most part from the same sources—namely, from respiration through the skin and lungs. Special circumstances may very much increase the quantity of organic matter; for instance, the presence of corruptible substances in the house, and, as I have repeatedly stated, the cleaning of unoiled floors with water or damp cloths.[1] Dark rooms contain more organic matter than light ones [since in the latter organic substances are more rapidly oxidized].

The vegetable and mineral dust particles in dwellings come partly from out-of-doors through windows, doors, cracks, and crevices, and partly originate from within through the wear and beating of the furniture, clothing, etc.

Putrid gases may mingle with the in-door air from the emanations of human excrements, privies, sewers, kitchen sinks, soiled linen.

When the windows are closed, ozone is entirely wanting within doors.

The water contents of the air in a dwelling are much more constant than in the out-of-door air, doubtless in consequence of the fact that furniture and walls have a regulating effect. In my sitting-room, which is kept well ventilated, and is situated in the second story, the water contents of the air only vary between 40°–66° except in the

[1] The examination was made before the rooms were cleaned and three hours later, and by means of permanganate of potash.

heated room in winter, when the atmosphere without is very dry. It sinks then lower than 40°. Inside of a dwelling-house the air in the basement shows the greatest amount of moisture. A room in my basement, with a lime composition floor, rarely contains less than 66° in the air, on an average throughout the year 69.5°; while one adjoining with a brick floor, is seldom 70°, on an average 77.5°. Of two rooms in the same story, other things being equal, one lying to the north has greater moisture than one lying to the south. In my house the relation is 58 : 53, estimated from the yearly averages.

The temperature of the dwelling depends first upon that of the walls, which themselves are affected by the temperature of the air without and the rays of the sun. It depends also upon the temperature of the ground air streaming in, upon the sources of warmth in the house itself, and on the amount of ventilation. Of all the different rooms, those under the roofs show a temperature most nearly corresponding to the outside temperature in all seasons of the year; those in the basement, on the contrary, are least influenced by the temperature outside.

The temperature of the in-door air during the hot season is of especial importance for the hygiene of the child. The heat imparted to the walls by the sun's rays is then very considerable, because the sun shines a greater portion of the day, and because the rays impinge more nearly at a right angle. Flügge[1] found, under unfavorable circumstances, the temperature on the outer wall to be as high as 37° C. I found in the summer of 1879 41.5° C., and recently, on the twenty-second of June, 1881, at a quarter past two o'clock in the afternoon, 44.5° C. The warmed walls absorb the heat in its totality with comparative slowness, imparting it just as slowly but constantly to the air within: they act as heat reservoirs, as stoves. They have

[1] Beiträge zur Hygiene, 1879, p. 3.

their highest temperature late in the afternoon, the lowest early in the morning, at about seven o'clock. The curve running between both extremes shows irregularities, makes leaps, only when there has been a decided cooling off of the atmosphere, especially through rain. The heating of the roof is also of importance. When the sun's rays fall at a favorable angle upon a dark-colored roof (covered with *carton-de-pierre*), the heat is very considerable, and exerts a powerful influence over the temperature of the uppermost rooms.

The rooms themselves also show in summer very varied temperature. It rises most in south rooms of the roof and in the next story below, and falls lowest in north rooms of the basement. In those first mentioned I observed the thermometer at 38° C., in the last not above 19.8° C. Again, the greatest daily variations are found in the south rooms of the roof. Differences occur of 14°–15° within twelve hours, because of the thinner walls and roof, which let the heat through more easily, but also—as during a rain—more easily cool off. In the basement the variations are far less striking, rarely exceeding 2° C. from morning to morning. The other stories maintain the middle place as regards temperature. They give a more correct picture of the climate in summer, while the top rooms are essentially dependent for their temperature upon the heating of the roof, and the basement upon the temperature of the cellar bottom. However, we must remember that the rooms on the first floor are influenced by the coolness of the basement, and the story next to the top by the warmth of the rooms directly under the roof. These middle stories vary in temperature less than the topmost ones and more than the basement. The greatest warmth observed by me in a south room on the first floor was 27.5° C., while in a north one in the same story I only found 24° C. The greatest warmth in a south room of the second story was 28.2° C., in a north

room of the same floor 24.6°. Then, too, in these stories the property of walls of storing up heat and slowly giving it off, like tiled stones, asserts itself much more. Therefore, if a cooling off of the outer atmosphere have occurred, the first and second stories are not the first to feel it. The change proceeds slowly after putting in so rapid an appearance in the rooms under the roof.

Furthermore, as has been said, the summer temperature inside of a house is essentially modified by the amount of ventilation. If, late in the evening, after sunset, when the air becomes cooler, doors and windows be opened, a temperature may be attained which in the top story, with its thin walls, and in the next story below is a good deal lower and lasts quite a time. In the first floor it is less noticeable and does not last as long. [This kind of ventilation is indispensable, for natural ventilation does very little in the summer, owing to the small difference between the temperature outside and inside.]

The influence of sunlight in dwelling apartments, manifests itself chiefly in this, that in consequence of the chemical effect of the sun's rays less organic matter exists in rooms so illuminated. It is known that the offensive products of respiration by skin and lungs remain much longer in the badly illuminated north rooms of a house. Besides, the sun dries the walls more and renders them more suitable for ventilation.

The ground influences the salubrity of a house through its moisture as well as its temperature, also through the nature of the ground air in the dwelling and the accompanying emanations or organic germs. This influence is perceptible first and most in the lowest apartments, but may often be traced more or less distinctly to the higher ones.

[The influence of miasmatic emanations from the ground is especially important in malarial districts. The ground moisture has recently been shown to be an influential predisposing cause of tuberculosis.]

On account of the great sensitiveness of the child's organism the most healthful rooms in the house should be chosen for the habitation of the young.

The basement and the rooms under the roof are the worst for them, the former because the air is damper and richer in carbonic acid and there is less light; the latter because the temperature is so variable and at times too high. The first and second stories on the south or east and west sides are best. Apartments looking out on the court are never to be recommended for children, because they are poorly supplied with good air and light.

The room in which a new-born child is to remain should be a healthful one in general and besides should have some especial qualities. Above all, it must afford sufficient protection to the sensitive eyes and the no less sensitive hearing of the infant. For this purpose the light should be admitted only in limited measure during the first fourteen days. Immediately after the birth the room should be almost dark and should slowly be made lighter, a little from day to day. It must also be situated remote from loud noises. It is true that the hearing is but imperfect during the first days, but it develops rapidly, and every violent irritation, in view of the irritability of the child's organism, may do harm. The temperature of the room should not be less than 19°–20° C., neither should it be much higher, if it can be avoided. Frequent ventilation must not be neglected.

Rooms for older infants, and for children from one to five years of age, should have abundance of light. It does not hurt [but strengthens] the eyes. Light helps to purify the air of the room, and also favors the molecular nutritive changes in the child's tissues.

Milne-Edwards[1] found that by withdrawing light from animals which develop in the water, he materially retarded their growth. Moleschott[2] showed that light quickens

[1] "Nach Gesundheit," 1880, No. 12.

[2] *Wiener medicin. Wochenschr.*, 1853, p. 161; 1855, p. 681.

molecular changes, increases the absorption of oxygen and elimination of carbonic acid, and increases the liveliness of the child. These observations have been confirmed by Béclard,[1] Pott,[2] Selmi,[3] Pflüger and Platen.[4] The amount of carbonic acid eliminated proved also to be greater when the light fell upon skin and eyes than when it fell upon the skin alone; but that light also quickens molecular change directly, without the mediation of the eyes, appeared from experiments with animals which had been made blind. Indeed, Moleschott found that tissues which had been separated from the body gave off more carbonic acid under the influence of light than in the dark, and that this was especially true of muscles. According to his experiments with birds and mammals, blue-violet and red light do not increase in the same degree the amount of carbonic acid eliminated, but the former increases it far more than the latter. Thus the chemical rays stimulate molecular change more than the heat rays. An observation of Demme is interesting, according to which the temperature of little children is lowered .5° C. through abode in dark rooms. These are all statements which are of the greatest interest to the hygienist and which deserve this interest all the more because practice has long ago recognized the importance of light for the welfare of the human organism and particularly of the child.

The room should not only be sunny, but have pure air, which, for children even more than for grown persons, is the chief condition for the maintenance of health. Therefore the former should not sleep in the rooms in which they remain during the day; soiled clothing should not be kept there, nor should washing be hung there to dry. The great dangers with which air thus contaminated threat-

[1] *Comptes Rendus*, xlvi., p. 441.

[2] "Untersuch. über Resp. und Persp."

[3] Rendiconti dell' Istituto Lomb., 1870, iii., p. 51.

[4] *Arch. für Phys.*, 1875, p. 263.

ens the health of children have been shown by an observation made by Peters in the Bonn Asylum, in which an epidemic of dysentery was traced to the drying of children's clothing in the nurseries. That care should be taken to remove excretions from the room as speedily as possible goes without saying. Thorough airing of the room by opening doors and windows is indispensable.

The nursery floor is best painted with an oil-color, that no dampness may enter it, and in order to facilitate the removal of dust and dirt. It is well to lay down rugs to make it warmer and better protect the children from hurting themselves.

Pay the greatest attention to the temperature of the room. Not only too cool, but too warm air is injurious to infants, as has been said. Let the temperature of the nursery during the cool season be 15° R. = 19° C. To obtain this warmth for a nursery it is most advantageous to use a tiled stove, which heats more evenly and with which there is no danger of burns. Iron stoves should be banished, for reasons to be discussed later, or at least be surrounded with a wooden lattice-work to prevent the children from injuring themselves on the edges or hot surfaces. [In America the open grate or the Franklin stove are the best, the steam radiator the very worst possible, modes of heating.]

The temperature in the hot season is best modified by airing the room during the night and then letting down the shades. An excellent means of cooling off the topmost rooms of a house is to sprinkle or pour water on the roof, when this is practicable.

To forestall accidents, the windows should not reach down too near the floor, and it should be impossible for children themselves to open them.

For artificial light hanging lamps may be used, which are suspended too high for the children to reach. For illuminating material do not have gas, because it dries the air

too much and too frequently contains injurious mixtures, but use oil, which, in a lamp properly constructed, deteriorates the air the least.

The nursery should contain but little furniture, since it lessens the space and the children may easily injure themselves on its corners and edges. Children's chairs must be so made that the feet have a support. The tray on the chair, which holds the playthings, should also be at just the height to admit of the child's remaining in a straight position. If it is too low the little one bends over; if too high it will try to bring the playthings nearer the eye, and this may be harmful. Of course the chair must have such a frame that it cannot fall over when the child makes violent movements. It should be well planed, without edges, and should not be painted with colors which are poisonous or which come off when wet.

The old-fashioned chairs for children had a very broad base, were without legs, and resembled somewhat the ordinary kitchen salt-box.[1] Now they are made more graceful and sometimes much more complicated, but not always more practical. Our child's chair in common use has four long, slender legs, a foot support, a seat, tray, and back. The base is often so narrow that slight contact of other children may cause it to tip. It may also be had on rollers. The one made by Gifhorn (Berlin) is such a chair. The automatic chair of Schildbach serves for sitting and for walking. If the child is to sit and play a board is let down upon which it is placed or seats itself; before it, at the height of the elbows, it finds a tray for its playthings, while the feet rest upon the floor. If the child wishes to walk the seat is pulled up backwards, the tray simply pulled up and fastened, and the child stands perfectly free. The legs of the chair are provided with rollers covered with rubber, which turn in every direction and allow the child to walk straight

[1] Ploss: "Das kleine Kind vom Tragbett bis zum ersten Schritt," 1881, p. 105.

ahead or to either side. Motion backwards is prevented by a bar arrangement.

The child's combination set of Krimmel—by no means a suitable thing—is table, bed, cradle, and rolling chair in one. It is a high chair, which may, with little trouble, be transformed into a wagon, a two-seated rolling chair, or a cradle.

Besides the chair nothing but playthings should be allowed in the nursery—for instance, a swing, rocking-horse, and so forth. Children's close-stools of course belong elsewhere. They must be so arranged as to be hermetically closed.

The place where older children remain will, as a rule, also be their room for study. In consideration of this it must first of all have sufficient light and must contain furniture of proper construction for use in preparing lessons. It is clear that in this furniture, essentially the same principles must be observed as in case of school-desks. A suitable arrangement is the work-table of Hermann.[1] This it is possible to adapt to the growth of the child. It is regulated by loosening two screws, whereupon the part bearing the top and the shelf may be let up or down in grooves and screwed tight. By means of two different iron adjustments the movable top may be turned into a reading-desk or fixed in a horizontal position for the child when at play. The distance between seat and foot-rest is altered by moving the latter, the height of the arms of the chair is changed by means of round-headed screws, over which the supports may be moved up and down in grooves.

AMOUNT OF VENTILATION NEEDED BY CHILDREN.—AIR SPACE.

Children's need of ventilation, corresponding to the greater amount of carbonic acid eliminated by them, is

[1] Hermann in *Monatsblatt für öffentliche Gesundheitspflege*, 1879, No. 9, p. 130.

relatively greater than that of adults, a fact which is unfortunately too little regarded.[1]

From a health standpoint, the cubic air space required for a child should not be less than 12 cubic metres an hour. (See note.)

But the amount of air usually afforded is much less than this.

For an adult is habitually reckoned only	20 cbm.,
then for the child of 8 years is allowed	8 "
" " " 12 " " "	$13\frac{1}{3}$ "

If we accept this very small quantity, there is necessary for a family with 3 children at the ages of 8, 10, and 12 years an air space of

$$\left.\begin{array}{r} 2 \times 20 \text{ cbm.} = 40 \text{ cbm.} \\ 8 + 11 + 13\frac{1}{3} \text{ " } = 32\frac{1}{3} \text{ " } \end{array}\right\} 72\tfrac{1}{3} \text{ cbm.}$$

This is a quantity of air very, very seldom attained among the laboring classes, and yet with this the air must

[1] A boy of 8 years eliminates in 24 hours 440 grammes of carbonic acid.
" " " " " 1 hour 18.3 " = 9.15 litres "

Reckoning the carbonic-acid contents of the air outside to be $.5\frac{0}{00}$, and the maximum carbonic-acid contents of the air inside permissible to be $.7\frac{0}{00}$ (for children the largest possible percentage), the need of ventilation, according to the formula of Schultze and Märcker, is

$$y = \frac{.009 \mid 5}{.0007 - .0005} = 45{,}500 \text{ litres or } 45.5 \text{ cubic metres of air in an hour.}$$

A boy of 12 years eliminates in 1 hour 30 grammes = 15 litres carbonic acid; according to the formula the need of ventilation is

$$y = \frac{.015}{.0007 - .0005} = 75 \text{ cubic metres of air an hour.}$$

Since this need (according to $y = \frac{.0226}{.0007 - .0005}$) amounts to 113 cbm. for an adult, a boy of 8 years $= \frac{2}{3}$ of an adult and a boy of 12 years $= \frac{2}{3}$ of an adult; or

5 children of 8 years, as far as need of air is concerned, = 2 adults; and
3 " " 12 " " " " " " = 2 "

Reckoning the space of air for an adult at	30 cbm.,
the child of 8 years must be allowed	12 "
" " 12 " " "	20 "
Reckoning the air space for the adult at	25 "
the child of 8 years must be allowed	10 "
" " 12 " " "	$16\frac{1}{3}$ "

be renewed more than five times an hour in order to cover the family's need of ventilation (= 406 cbm. per hour). I know numerous dwellings in which there is no greater space than 50 cbm. altogether for a family of 4 to 6 children.

The little children, who cannot be much out-of-doors, are all especially menaced with the dangers of the bad air.

It is all the more lamentable that it is in the lower classes where we find so little care for ventilation, where, indeed, the presence of children is made a pretext for not airing. The windows are anxiously kept closed day after day, and paper is even pasted over the cracks to keep out a draft, but not a thought is given to the fact that many of the most serious diseases of children arise in consequence of the exclusion of pure air.

THE SLEEPING-ROOMS OF CHILDREN.

The bedroom of children should only be used to sleep in, and should be as clean as it can possibly be made. It is a mistake frequently made to allow large, healthful rooms to remain unused the greater part of the year, and give small rooms with low ceilings and a less healthful situation to the children to sleep in. Their longer time of sleeping, and relatively large elimination of carbonic acid, demand that the room assigned them be large and especially well ventilated. The child's need of air and the corresponding amount of space have just been discussed ; according to the figures given, the relation between the number of beds in a room and the size of the children must be measured. But taking into consideration that during the night it is usually only the natural ventilation which is going on, we must calculate upon the highest number of cubic feet of air—that is, for a child of 8 years not less than 12 cbm. of space ; for a child of 12, not less than 20 cbm. Even with such an amount of space, too much carbonic acid is often allowed

to accumulate, especially in summer, when natural ventilation, as we have seen, is but small. A boy of 12 years produces in 9 hours of sleep 135 litres of carbonic acid; these added to the 10 litres contained in the 20 cbm. of his apartment make 145 litres. If the latter should accumulate, the air of the room would contain at the end of that time $\frac{7}{1000}$ carbonic acid.

But it should never exceed 0.7 $\frac{0}{00}$. From this we see how necessary it is to ventilate the sleeping-room well, and how necessary it is to increase the space for air in which the sleeping child is placed. Where in any way attainable, the bed of a child of 8 years and under should stand in a space of 20 cbm.; that of a child over 8 years, in a space of 30 cbm. It is necessary to air the sleeping-room the whole day, and during hot weather to further ventilation in the night by putting in gauze windows. For children to sleep with open window during the cold season is not allowable in our climate, but is permissible during the summer when the air does not stream directly in upon the children, and the latter are not in earliest infancy.

The temperature in winter should not be allowed to fall below 18° C. for young children, and not below 12°–15° C. for older ones. To effect this, the sleeping-room must be one which may be heated. In order to avoid excessively warm temperature in summer, rooms directly under the roof should never be used as sleeping-rooms. In other details proceed as indicated above.

Every sleeping-room must be properly darkened by curtains, since sunlight and even moonlight interfere with quiet sleep. [Shades and blinds are much better than curtains; for the latter diminish the airiness of the room, collect dust, and especially retain the contagion of the numerous infectious diseases to which children are liable.]

Night lamps should be avoided, for they contaminate the air by the production of carbonic acid. [Nursery wax

tapers are not objectionable. Many are in market arranged to burn a certain number of hours, giving just light enough to see when the child stirs.]

BEDS.

The bed should promote quiet sleep, keep the body properly warm, and allow it the necessary perspiration, and should be clean and entirely free from all odors that are disagreeable or directly injurious.

The infant, from birth on, should have a bed of its own. True, the mother's bed would be able to communicate to it the warmth which benefits it so much, especially in the first weeks of life, but there are many dangers which threaten a child sleeping with its mother. As long as the lochia flows the air of the mother's bed is not sufficiently pure for the child. Then there is a possibility that the mother may roll over upon the child in her sleep. This used to happen with comparative frequency when it was the general custom to have infants sleep in bed with the mother until they were old enough to wean, and it is even now not a rare occurrence. In the last century in Sweden, 650 infants, on an average, were annually smothered to death in sleep. In the present century in England, 1.4 : 1,000 children born died in this manner, in Scotland 1 : 1,000. In London, 1878, 503 infants were thus smothered, *i.e.*, 3.9 : 1,000, in Liverpool 8.4 : 1,000, in Birmingham 9.3 : 1,000, most of them in winter and in the night from Saturday to Sunday on account of the drunkenness of the mothers. A single coroner (Humphrey in Middlesex) lately reported that in his district from the 11th of November, 1880, to the 13th of December, 1880, no less than 49 infants were found smothered in bed.

How large the number is in Germany I cannot say, since the statistical data are wanting; it is no very small one, if I may judge from my own experience. But the

reality of the danger warns us to give a child a bed by itself, and never to allow the mother, wet-nurse, or nurse-maid to have the child sleep in her bed. [It is supposed that many of the above-mentioned infanticides are intentional.]

The best bedstead for an infant is a wicker frame of basket work standing on firm legs. Being woven, it allows ready ingress and egress of air, which of course is necessary. The box bedstead must be discarded, because it completely precludes ventilation of the bed from underneath and from the sides, thus furthering stagnation of bad air in its interior. A wicker basket without feet, such as Gölis recommended, and such as we sometimes meet with to this day among the lower classes, is inconvenient, because mother or nurse has to bend over too much, and is also unhealthful because it stands in the very lowest air stratum of the room.

Open bedsteads may be made of strips of wood or iron instead of basket-work. If of the metal, it is necessary to cover the edge with soft material.

Rocking bedsteads, cradles, are still much more frequently used than the fixed ones which have just been recommended. We have hanging and standing cradles. The former may be divided into hammocks, or hanging nets, in use by negroes, Indians, gypsies, *Korjäken*, islanders, and the so-called hanging cradles. The most primitive of the latter kind we find in Russia in the *gouvernement* Saratow. There the child is bedded on a piece of linen loosely stretched upon a wooden frame which is suspended from four ropes running together and fastened overhead. This swing the mother moves while at her spinning by means of a string passing from her foot up to the frame and following the treadle movement. The Slavic population of the *Spreewald* (near Berlin) has as primitive a hanging cradle. The whole apparatus consists of four staves fastened together, two by two, and diverging downward from a hori-

zontal cross-piece. This framework holds suspended an oblong piece of linen cloth, and upon this the child lies. The mother takes her child in its hanging cradle with her to the field. The Spanish-American cradle is a low, oblong basket suspended with four ropes bound to the corners and provided on three sides with a covering. The Tcherkask cradle is an oblong, shallow box hanging in hinges. Certain authors have entirely forbidden the use of the cradle. They have asserted that the circulation of the brain is too violently perturbated, and the child becomes dizzy and numb before going to sleep (Fürst). Others, however, and more reasonably, condemn not the moderate use of cradle, but its abuse, and violent rocking,—especially when irregular and jerking. This will disturb the infant's digestion, and cause vomiting.

Horse-hair mattresses are preferable to all others. Mattresses are also made of sea-grass, ferns, felt, wool, or feathers; but none keep off bad odors as do those made of horse-hair. The pillow should also be stuffed with horse-hair; it is less heating than feathers. For the poor, sea-grass mattresses are recommended.

It is best to spread over the mattress a woollen blanket doubled, and over this a linen sheet. Many regard a layer of waterproof material in the bed injurious, especially since it is a good conductor of heat. But if it is put under the sheet and is itself thoroughly cleansed, it is of decided advantage, since it protects the bed, which it is much more difficult to keep clean. A feather pillow is used [in Germany only] as a covering for new-born children, because it is warmest; for older infants woollen blankets are better beyond comparison, because they permit freer ventilation of the body. Let the temperature of the room decide the thickness and number of these; one, in summer, is quite sufficient.

Cradle and bed should always be placed where the light does not come to the child from the side, but from the end

where the head is. In the former case one eye would get more light than the other when the child awakes, and this should be avoided, since it may cause a child to look cross-eyed. The infant must lie in the bed stretched at full length on its back, with the head but slightly raised; then the movement of the chest is not cramped, the spinal column is not wrongly curved, and the circulation of the blood in the arteries of the neck is not interfered with. A child should never by any contrivance be bound down or tied in bed so that it cannot move freely. This pernicious custom is very widespread. Children are put into bed and bound down with a strap over the blankets, or, as Rüdiger[1] reports arms and feet are tied to the cradle-posts. In many localities children are allowed to lie so for hours, or for half a day, and are not loosed from their position even when they receive nourishment. The great hygienic disadvantage is evident; the body needs for its development free activity and movement of its limbs and free perspiration, and cannot endure the uncleanliness which is a necessary consequence of so long bondage.

In order to keep bright light away during sleep, it is well to fasten curtains of dark gauze, or muslin, to a perpendicular rod at the head of the bed and let them fall over the sides.

As regards the beds of larger children, the first requirement is that each child have a bedstead for itself. From considerations of health and morality it should be strictly prohibited that several children sleep together, or that a child sleep with an adult. A good night's rest is not to be expected when each person cannot stretch out his limbs comfortably. The lung and skin exhalations of each must come in contact with the other to his injury. Contagious diseases are spread to a great extent by sleeping with others, and, finally, the moral disadvantages are so apparent that it is unnecessary to describe them.

[1] Rüdiger, "Die Sterblichkeit der Kinder im ersten Jahre," 1868, p. 14.

Yet how frequently we meet with the habit of sleeping two in one bed! It is not at all rare among the lower classes for families of 6–7 persons to have only two beds, especially in the country. Even here in Rostock, where the economic condition is by no means bad, I have seen four children lying in one bed. In the middle classes also it is very common for two children to sleep together. In other districts circumstances are much more unfavorable. The *Correspondenzblatt des ärztlichen Vereins von Thüringen* (June 25, 1881) reports in one place, in the Rhön district, the following condition:

1	household	of	7	persons	with	1	bed,
2	households	"	10	"	"	2	beds,
4	"	"	9	"	"	2	"
6	"	"	8	"	"	2	"
21	"	"	7	"	"	2	"
5	"	"	10	"	"	3	"

CHAPTER VI.

CARE OF THE RESPIRATORY ORGANS.

The chest of the child differs in many respects from that of an adult, particularly in the first years of life. In the new-born child it is almost always well arched; the upper aperture faces directly overhead, so that its anterior extremity is situated higher, with relation to the posterior extremity, than in later years. The inferior border of the chest is raised up more over the abdomen; the borders of the costal cartilages do not run precipitately from the middle downwards (Henke[1]). The axillary line is not much longer than the breastbone.

The difference with reference to diameters is very considerable. A cross-section of the thorax of the new-born child is almost square, its sagittal antero-posterior diameter is almost exactly like the transverse. But the latter gradually outstrips the former; for from birth until the tenth year the sagittal grows but 7.2 cm., while the transverse grows 13.1 cm. (Hueter[2]). The details of this growth are given in the note.

[1] Henke, in Gerhardt's "Handbuch der Kinderkrankheiten," 1877, vol. i., p. 245.
[2] Hueter, "Die Formentwickelung am Skelet des menschlichen Thorax," 1865.

	Thorax of the new-born child.	Thorax of child ten years old.
Sagittal diameter, top	4.7 cm.	11.9 cm.
in the middle .	5.6 "	11.2 "
bottom . . .	6.0 "	14.3 "
Transverse diameter, top	5.3 "	18.4 "
in the middle .	6.8 "	19.1 "
bottom . . .	8.3 "	19.0 "

The increase in the circumference of the chest may be taken as a criterion of the general development of the child, as has already been stated. In the new-born child the circumference of the chest, taken at the level of the nipples, never exceeds the circumference of the head, but is, as a rule, 2½–3 centimetres less. The average circumference of the chest is 34 cm. If the chest be smaller in proportion to the head, it is a sign of weakness. If the dimensions of head and chest are equal, it is a sign of exceptional vigor in the child. The chest circumference gradually gains upon that of the head, and in very strong children may overtake it as early as the twenty-first month.

But on an average the two dimensions are not equal till the beginning or middle of the third year. If, at the age of three, the chest circumference is still smaller than that of the head, the child is decidedly weak (Vierordt).[1] At five years the chest should measure 2 cm. more than the head; at eight years, 4–5 cm. more; at fourteen years it should be 11–12.5 cm. more. Thus from the end of the third till the thirteenth year the chest circumference grows slowly and rather uniformly; but from the thirteenth year there is a sudden increase in the rate. This fact is of great importance, for it is just at the thirteenth year that many children are habitually exposed to influences which are especially

[1] Physiol. des Kindes, in Gerhardt's "Handbuch," 1877, i., p. 83.

In the first 6 months the chest circumference grows almost 10 cm. In the following 15 months the chest circumference grows almost 10 cm., so that it measures about 54 cm. with 21 months.[1]

Its growth in the time following is shown in this table:

At the age of		36	months	it measures	almost	57	cm.
"	"	45	"	"	"	58	"
"	"	66	"	"	"	60	"
"	"	91	"	"	"	62.5	"
"	"	120	"	"	"	65	"
"	"	136	"	"	"	66	"
"	"	171	"	"	"	72.5	"
"	"	190	"	"	"	78	"[2]

[1] Liharzik, "Das Gesetz des menschlichen Wachsthums," 1858, p. 108.

[2] *Ibid.*, p. 108.

injurious to the development of the chest—thus at school or in factories. This also is the age when girls are put into corsets with the express purpose of restraining the normal expansion of the trunk characteristic of adolescence.[1]

The chest circumference, which at birth is under the normal, remains in all periods of growth somewhat smaller than it should by $\frac{1}{7}$, $\frac{1}{5}$, or even $\frac{1}{3}$.[2]

The normal development of the thorax, in general or in one dimension, may be disturbed by various causes. Rachitis always affects the thorax, and may bring about complete deformity of the chest, transverse contraction, or "chicken-breast." Another cause is a wrong action of the respiratory organs situated in it. Then, too, a faulty position of the end of the spine produces, first, a lateral curvature of the spine, and, as a further consequence, unsymmetrical development of both sides of the chest.

[1] Kotelmann gives the following measurements from students of the Hamburg gymnasia:

9	years,	chest	circumference	=	60.75	cm.	
10	"	"	"	=	62.46	"	growth = 1.71 cm.
11	"	"	"	=	63.88	"	" = 1.42 "
12	"	"	"	=	65.81	"	" = 1.93 "
13	"	"	"	=	67.15	"	" = 1.34 "
14	"	"	"	=	71.09	"	" = 3.94 "
15	"	"	"	=	75.22	"	" = 4.13 "
16	"	"	"	=	78.41	"	" = 3.19 "

"Die Körperverhältnisse der Gelehrtenschüler," 1879, p. 45.

[2] If it measures only 26 cm., with a head periphery of 35 cm.,

in the	21st	month	it measures	$44\frac{1}{2}$ cm.
"	66th	"	"	$49\frac{1}{3}$ "
"	91st	"	"	$51\frac{1}{3}$ "
"	136th	"	"	54 "
"	171st	"	"	$59\frac{1}{3}$ "
"	190th	"	"	$63\frac{1}{3}$ "

If it measures only 30 cm., with a head periphery of 35 cm.,

in the	21st	month	it measures	49 cm.
"	66th	"	"	54 "
"	91st	"	"	56 "
"	136th	"	"	59 "
"	171st	"	"	$65\frac{1}{2}$ "
"	190th	"	"	$70\frac{1}{2}$ "

Liharzik, "Das Gesetz des menschlichen Wachsthums," 1858, p. 110.

Respiration.—The first breath drawn by the child is caused by the irritation which carbonic-acid gas, accumulating after placental communication has ceased, exerts upon the respiratory centre in the medulla oblongata. If this irritation is not strong enough, or the respiratory muscles (as in children prematurely born) are not sufficiently well developed, or if there is some mechanical hindrance, the full development of the lungs may be affected. With these pathological conditions we are not concerned; they belong to obstetrics.

The frequency of respiration is greater throughout childhood than in adult life. In one minute

a new-born child	breathes	35	times		
a child of	12	months	breathes	27	times.
a "	2	years	"	25	"
a "	6	"	"	22	"
a "	12	"	"	20	"
an adult			"	15–17	times.

These are figures which I have obtained as average ones from observing for years my three perfectly healthy children. The observations were taken during their sleep. When awake, children show, as a rule, a somewhat greater frequency of respiration than that just indicated.

Respiration, especially in the first 5–6 years, is not quite uniform; that is, even in perfectly healthy children the breathing is alternately deep and superficial, and the intervals between expiration and inspiration are often of different lengths.

All children in the first part of their life breathe abdominally, therefore with the diaphragm; the respiratory muscles of the chest are only gradually put into action. The diaphragm breathing may almost always be found to be still prevalent in children eight or nine years old, the age when they are attending school. According to Sibson, the typical form of the respiratory movements does not begin to develop until towards the tenth year, and in girls earlier

than in boys. "In the former the upper and middle parts of the chest enlarge, while in older boys it is the lower aperture of the chest and the upper abdominal region which are the most rounded" (Vierordt, *loc. cit.*, p. 131).

These facts are of great hygienic importance.

The maximum of the air capacity of the lungs is relatively larger in childhood than in adult life.[1] The air exhaled by the lungs of a child is relatively richer in carbonic acid than that from the lungs of an adult. This shows itself especially in the last period of childhood, and then more in boys than in girls.[2] [This excess of carbonic

[1] It amounts to:

400–500	cbm.	in the	age	of	3–4	years.
900	"	"	"		5–7	"
1383	"	"	"		8–9	"
1863	"	"	"		12	"
2489	"	"	"		14	"
3300	"	"	"		adults.	

Schneff (Influence de l'âge sur la capacité vitale des poumons. — *Gaz. méd de Paris*, 1857).

The annual gain in the maximum of air capacity increases remarkably at the time of puberty. This capacity was estimated by Kotelmann to be

in	9-year-old	boys	in the	gymnasium	1771.15	cbm.,	
"	10	"	"	"	1865.45	"	gain of 94.30 cbm.
"	11	"	"	"	2021.66	"	" 156.21 "
"	12	"	"	"	2177.41	"	" 155.75 "
"	13	"	"	"	2270.28	"	" 92.87 "
"	14	"	"	"	2496.15	"	" 225.87 "
"	15	"	"	"	2757.69	"	" 261.54 "
"	16	"	"	"	3252.97	"	" 495.28 "
"	17	"	"	"	3553.52	"	" 300.75 "
"	18	"	"	"	3686.11	"	" 132.39 "

There is still great lack of accurate measurements concerning the amount of air conducted to the lungs during one inspiration, but the assumption is that this too is relatively greater in the child than in the adult. This is probably not the case, however, until the respirations become deeper and the thorax is extended in the diagonal direction also.

[2] The lungs of a boy of 8 weighing 20.8 kil. give out in 24 hours 439.93 grm. CO.

"	"	"	"	10	"	25.0	"	"	24	"	598.30 "
"	"	girl	"	10	"	23.0	"	"	24	"	458.43 "
"	"	"	"	10	"	24.0	"	"	24	"	527.91 "
"	"	boy	"	12	"	31.0	"	"	24	"	730.27 "
"	"	girl	"	13	"	35.0	"	"	24	"	536.00 "

Since grown persons with average weight of 75 kilos (150 pounds) expel only 900–950 grammes in 24 hours, it is clear that the child gives out a greater amount for

acid results from the great rapidity of molecular tissue-changes in the child.] Liability to respiratory diseases is especially great among children between two and five years old in winter and spring. The liability is especially marked for those who are kept in impure air. The first thing needed in the care of the respiratory organs, is to secure the proper growth and development of the thorax. Care must be taken to avoid hindering the depth of the respiratory movements by improper clothing which may bind the infant too tightly, even with the navel band.

Later there is the same danger from corset-waists, especially when they are worn before the time when thoracic breathing is fully developed. Also, in boys, from belts or straps which hinder the expansion of the lower region of the thorax. Finally, there is to be avoided an improper position of the trunk when lying in bed or sitting, especially in the school. It has been said that during a large portion of childhood breathing takes place almost exclusively through enlargement of the thorax in the longitudinal axis, instead of transversely; all the more injurious, therefore must be the effects of long-continued sitting, particularly with the upper part of the body bent forward.

But hygiene has more to prescribe than merely the removal of obstacles to the respiratory movements; it should go further and insist upon lung gymnastics, especially for all those whose thorax is backward in development and those who at times, as in school, are prevented from breathing with the normal depth of respiration. Besides free romping, systematic exercises of the body are useful. They further the chest expansion, and after a time effect an increase in

an equal weight of body. A boy of 8 years has not reached one third the weight of an adult, and gives out nearly half as much carbonic acid as an adult; a boy of 12 years has not reached one half of an adult's weight, and expels an amount of carbonic acid equal to more than $\frac{2}{3}$ of the quantity eliminated by the adult. This is what physiology tells us.

chest circumference. Leo[1] found this to be in recruits as much as 2–4 cm., Abel[2] in gymnasts 26–52 mm., Hammersley[3] on an average 41 mm. Proof will be later given that swimming and skating secure lung gymnastics.

The purest air possible must be provided, without which it is impossible to secure normal activity of the respiratory organs and their permanent soundness. More has been said about this in another place, in discussing the nursery and sleeping-room; I will only say here that the child should be out-of-doors as much as possible every day. Experience teaches that in the warm season of the year a child three weeks old may very well be taken out-of-doors for a little while, but that this should not be undertaken in the cold season until eight weeks have elapsed. It may be accustomed to the out-of-door air by lengthening more and more, except in bad weather, the time of its daily airing. From the second year on it should be out-of-doors, in fair weather, at least two and a half or three hours daily; this is absolutely necessary when it begins to go to school.

[School attendance is often made an excuse for depriving a child of its daily quantum of air, whereas, as the author points out, the period of confinement necessitates so much more care in securing out-door air at other times. In summer, children should be out-of-doors almost all day long.]

PROTECTION OF THE RESPIRATORY ORGANS FROM DISEASE.

The best way to protect the respiratory organs is to try, in the manner just described, to promote their normal development and function. Numerous acute and chronic diseases may be thus averted. But the fact that the cool season of the year and sudden changes of temperature do so often occasion in little children affections of the throat,

[1] Leo, *Zeitschrift für Medicin, Chirurgie u. Geburtshülfe von Küchenmeister*, vol. iv., p. 88 *sqq*.

[2] Abel, *Preussische Militärärztliche Zeitung*, 1861, p. 248.

[3] Hammersley nach Roth und Lex, "Militärgesundheitspflege," vol. iii., p. 206.

bronchial tubes, and lungs compels us to consider still other means of protection. These we find in careful, systematic bathing and washing of the skin, in suitable clothing, and gradual habituation to change of temperature. Nothing disposes a child more to catarrhs of the organs of the chest than over-anxious exclusion from the air, on the one hand, and, on the other, too rough hardening, too reckless exposure, and too light clothing. One must keep to the golden mean, and this cannot be done by fixed rule, only by individualizing. One thing is not good for all, and the respiratory organs should always receive protection according to the constitution of the individual.

Since general experience and statistics show that children in their first year, especially in winter and spring, are often attacked with respiratory diseases, precaution is at these times necessary. The temperature of the out-of-door air, and especially any winds that may be blowing, must be taken into consideration. North and east winds are the most injurious on account of their dryness. It is of still greater importance for infants to take care that the transition from the warm room to the cold air be effected gradually.

Particular precaution is necessary when children are teething, since many are then very much disposed to catarrhs of the throat and bronchial tubes.

Children who, from infancy or ever since recovery from an affection of the respiratory organs, have retained a disposition to such diseases must receive careful attention. According to my experience, nothing is more beneficial to such individuals than what I have before advised in these pages—the continual wearing of flannel shirts instead of those made of linen. Next to this come hardening baths for the neck and chest, applied with discretion, and eventually tranference to another climate, particularly to the sea-shore.

Children of suspicious *physique*, with narrow, flat chest, should, above all, be most carefully nourished both

during and after infancy. If the mother's health is uncertain, a strong and healthy wet-nurse should be found. The child should not be weaned too early, and *for years after weaning the principal nourishment should be cow's milk.* Besides, good, pure air in the rooms occupied by the child should be provided with the utmost care and, if circumstances allow, the child should be taken into the country for several months every year. As it grows older the lung gymnastics mentioned above should be practised with regularity but with due consideration to the individuality and also, if need be, with modifications. In all stages of development the child should be shielded as much as possible from even light affections of the chest, because in a case like the one in question they so frequently become chronic and may give occasion to more serious illness; and it should be guarded even more than other children against those diseases which in children of suspicious *physique* very frequently become complicated with serious disturbances of the respiratory organs, as *measles* and *whooping-cough.* Children attacked by either of the two diseases last named may in numerous cases, as has been suggested in another place, be saved from serious affection of the respiratory organs, by choosing the most healthful apartment in the house for the sick-room or the one in which the child is kept, and by using the greatest care to thoroughly ventilate and clean it. Accumulation of carbonic acid and organic matter in the in-door air is known to be one of the principal causes of bronchial complication of these infectious diseases.

THE VOICE OF THE CHILD.

The larynx of the new-born infant, aside from its small size, is characterized by the softness of its cartilages and the length of the part belonging to the glottis, which is but little shorter than its vocal part. In the beginning, it

is only capable of producing a crying sound; as early as the third month it serves also to express feelings of satisfaction. The growth of the larynx is at first comparatively slight and the compass of the voice also remains small. This changes from the sixth year on, when a considerable and constantly increasing enlargement of the physical function is observed.[1]

The voice of a girl gains in the time from the 6th–13th year four whole tones downwards and two upwards. The chest-voice of the boy in the age 8–14 years encompasses 7.5–9.2 tones of musical value.

From the 13th–14th year the larynx begins to grow decidedly faster and to differentiate according to sex. That of the male gains principally in the sagittal direction, that of the female in a vertical direction; thus it happens that the former has longer vocal cords than the latter. With entrance into puberty the larynx has nearly attained the dimensions shown in the adult.

This period of approaching sex maturity is also that of the *change of voice*, a change in its sound and pitch, especially observable in boys. In them the middle register sinks an octave, in girls two tones.[2] During this more or less rapid change the voice has a peculiar, rough, harsh sound, and breaks easily. The harshness is caused by a decided reddening and swelling of the cords, which, according to the researches of Fournié,[3] is, during the period of the change of voice, physiological.

The care of the voice is essentially coincident with that of the respiratory organs. It should receive especial care at the time of the change. This not only follows theoretically from the unusual vascularity of the mucous membrane, but daily experience teaches that failure to observe care at

[1] Vierordt, *loc. cit.*, p. 192 *sqq.*

[2] Hermann, "Handbuch der Physiologie," 1879, i., p. 109 (Grützner).

[3] Fournié: "Physiologie de la voix et de la parole," p. 545.

the time in question very frequently causes permanent injury to the voice. The reddened, swollen vocal cords should be saved from exertion in exactly the same manner as if there were genuine catarrh—that is, there should be no singing, shouting, and screaming, and abrupt changes of temperature should be as much as possible avoided. [Since boys shout immensely at this age, it is difficult to imagine this advice fulfilled.]

Exercise of the vocal organs begins very early in life with games accompanied with song, the child's greatest delight, and later is continued in music alone. But there is another exercise of the voice and speech, not in song, which is of interest to us, namely, a loud and noble delivery with correct emphasis and modulation (elocution). Such gymnastics were known also to the ancients, whose *Anaphonesis* stood in no mean repute as a hygienic expedient. Plutarch mentions this and its health value in the treatise De valetudine tuenda, cap. 15, im Sympos., vi., 1., also Pliny in Hist. nat., xxviii., 24. Without doubt they were right, for gymnastics of the vocal organs are also gymnastics of the chest and lungs. It is well known that certain defects or imperfections of the voice and speech may be lessened by its use,—and even the defect of stuttering cured.

CHAPTER VII.

CARE OF THE OSSEOUS AND MUSCULAR SYSTEMS.

The skeleton is, throughout childhood, but particularly in the first years of childhood, characterized by softness and elasticity much greater than in after life. This is why derangements of the normal development of the skeleton so easily occur in youth. The vascularity, and the more rapid metabolism (tissue-change) connected therewith, predispose to various inflammatory infections of bony tissue, as periostitis, caries, necrosis. The greater elasticity also, partly a consequence of the vascularity, predisposes to bending and curvature. Two parts of the body are most liable to the latter, the lower extremities and the spine, with the chest and pelvis. That the lower extremities suffer so easily from curvature is readily understood, for the whole weight of the trunk and head rests upon them. If the bone-tissue is not consolidated, or is insufficiently so, when suffered to bear the weight of the body, it will become curved and crooked, like a flexible staff which is held fast at the foot and loaded down at the top. Why curvature of the spine so easily occurs in childhood is not quite so easily explained, but is not less evident. All spinal vertebræ are first formed of cartilage, with a central spot of bone, called the "centre of ossification." But at birth this ossification has already extended to the investing periosteum, except at the upper and lower surface, that is, towards the neighboring vertebræ, there is still over the remains a considerable layer of cartilage, which passes into the fibro-cartilage of the intervertebral

ligament. This peculiarity produces great elasticity in the whole vertebral column. The shape of the latter at birth is by no means the same as in later years. After the erect posture has been assumed, the back becomes doubly curved by the weight of the body. But the vertebral column of the new-born infant continues in nearly a straight line throughout, and may, with ease, be bent backwards, forwards, and to either side. According to Budge,[1] the first permanent curve of the spine to form is that in the lumbar region which is directed forward. This, he says, is because the child, learning to stand alone, of necessity transfers the centre of gravity to the plane of support, and must therefore bend the spinal column backwards at the shoulders. According to Balandin,[2]—who ascribes to the spinal column of the fœtus a curve comprising both the thoracic and lumbar vertebræ—the first permanent curve which forms is that in the cervical portion of the spine, when the child in the third month tries to lift up its head, and thereby puts into action the muscles of the nape of the neck. In his opinion, the permanent curve of the lumbar portion of the spine results from the efforts of the child to stretch its legs. That by such efforts a lumbar lordosis is formed, is easily shown by extending the femur of a child lying supinely on a table and pressing it against the table. There always occurs then a convexity forwards of the vertebral region of the loins. If the child stands alone at the end of the first year, the centre of gravity is no longer anterior to, but directly over, the axis of the hip. In consequence of a vigorous extension of the upper part of the thigh and a strong progressive action of the *musculus sacrospinalis*, the lumbar curve previously formed is increased. Mechanical factors, therefore, always play a part; muscular exertion, weight of the head upon the spinal column; the change in the spinal column

[1] Budge, *Berlin. klinische Wochenschrift*, Nr., p. 50.

[2] Balandin, *Virchow's Arch.*, vol. lvii.

is one forced upon it, not actively assumed by it. It is important to see that this change is effected physiologically.

The development of the pelvis is mainly of importance in the female sex.

It was long believed that all children are born with either a round or an elliptical pelvis; but according to the investigations of Fehling this was a mistake. In his opinion, the oblique, oval pelvis is almost always to be found in the new-born infant. If this is true, that which has been assumed to be the cause of the transformation of the round pelvis is also incorrect. It was said, that the weight of the trunk, when the upper part of the body is erect, forces the sacrum down between the hip-bones; the latter, after slipping somewhat, will come to a standstill, in consequence of their wedge-like form, and the constant weight of the trunk will turn them a little forwards on their transverse axes. At the same time this weight presses the bodies of the sacral vertebræ a little forwards between the transverse processes, thus causing the gradual flattening of the sacrum. According to Fehling the pelvis undergoes its chief transformation in the sacrum. As a consequence of the increase of the lumbar curve under the weight of the trunk, the lower lumbar vertebra are forced forwards and downwards by compression of their connecting cartilages, and are brought more closely together. The first sacral vertebra is thereby drawn downwards with the others, and in turn acts upon the second, which yields, though in a very much lessened degree. The most extensive movement is made by the superior surface of the first sacral vertebra, and it is this which gives rise to the *promontorium, which develops in the third year.* Whether we accept the former or the latter explanation, it is incontestible that the position of the spinal column, and especially the curve of the lumbar region, has a decided influence upon the shape of the pelvis.

In the 7th–8th year, an important change takes place in the pelvis of the female. At birth the pelvis of the male

presents somewhat broader side portions than that of the female.[1]

From the time just indicated a greater development of these parts begins in the pelvis of the female, which soon outstrips that of the male in this respect. Whether this is the effect of pressure or of muscular action cannot yet be stated with certainty.

It is hardly necessary to draw attention to the fact that the development of the spatial relations of the pelvis is affected in a great degree by the existence of rachitis; but another fact which deserves prominence is, that whenever the body in general is backward, or stunted in growth, the pelvis also fails to reach its normal dimensions.

The muscular system of the new-born child is comparatively little developed, being but 23.4 per cent. of its weight, while in an adult it amounts to 43.09 per cent. of the weight. The muscles are paler, contain more water, and are more feeble, and increase very gradually in weight and firmness in proportion to the amount of nourishing material and exercise. Their capacity to do work is in the beginning both correspondingly and relatively very slight indeed, but soon increases, and in a boy of but six to seven years measures half of that of the adult, in a girl of fourteen reaches five sixths of that of an adult woman.[2]

[1] Hennig, Das kindliche Becken, in *Arch. für Anatomie u. Physiologie von His.*, 1880.

[2] Quetelet's measurements ("Physique sociale," ii., 1869) were made with the dynamometer of Regnier.

A boy of 6 years	has to	1	kilo	weight	1.16	kilo	drawing-power.	
" 7 "	"	1	"	"	1.41	"	"	"
" 8 "	"	1	"	"	1.60	"	"	"
" 9 "	"	1	"	"	1.76	"	"	"
" 10 "	"	1	"	"	1.87	"	"	"
" 11 "	"	1	"	"	1.77	"	"	"
" 12 "	"	1	"	"	2.01	"	"	"
" 14 "	"	1	"	"	2.09	"	"	"
While an adult	"	1	"	"	2.46	"	"	"

From the experiments of Kotelmann[1] it appears that the increase in circumference

[1] Kotelmann, "Die Körperverhältnisse der Gelehrtenschüler des Johanneums," 1879, p. 45.

THE FIRST MOVEMENTS OF THE CHILD.—STANDING AND WALKING.

The first muscular actions of the child are automatic, impulsive, and reflex. Reaching after objects held before it and holding up the head must be set down as the first voluntary actions. As a rule, neither is noticeable before the beginning of the fourth month, although in some instances they may be seen earlier. [This is rather a late

of the muscles of the upper part of the leg as well as the drawing-power and power of pressure is undoubtedly greatest towards the time of puberty. Thus the circumference of the upper arm increased (with the muscles in a contracted condition)

From 9–10 years	= .44 cm.	From 13–14 years	= 1.42 cm.
" 10–11 "	= .74 "	" 14–15 "	= 1.61 "
" 11–12 "	= .73 "	" 15–16 "	= 1.71 "
" 12–13 "	= .48 "		

According to him the average drawing-power [1] of the arms was:

In boys of 9 years	= 11.01 kilo.		
" 10 "	= 13.00 "	Gain	= 1.99 kilo.
" 11 "	= 14.22 "	"	= 1.22 "
" 12 "	= 16.13 "	"	= 1.91 "
" 13 "	= 18.05 "	"	= 1.92 "
" 14 "	= 19.73 "	"	= 1.68 "
" 15 "	= 25.16 "	"	= 5.43 "
" 16 "	= 30.57 "	"	= 5.41 "
" 17 "	= 33.78 "	"	= 3.21 "

Thus the drawing-power of the arms increased almost regularly to the fourteenth year, when it showed a very remarkable rise, which is not to be wondered at after what has been said concerning the growth of the muscles in circumference.

The author arrived at the following average values for the power of pressure of the arms:

In boys of 9 years	= 20.88 kilo.		
" 10 "	= 21.39 "	Gain	= 0.51 kilo.
" 11 "	= 23.33 "	"	= 1.94 "
" 12 "	= 25.51 "	"	= 2.18 "
" 13 "	= 26.74 "	"	= 1.23 "
" 14 "	= 31.10 "	"	= 4.36 "
" 15 "	= 36.37 "	"	= 5.27 "
" 16 "	= 42.53 "	"	= 6.16 "
" 17 "	= 47.14 "	"	= 4.61 "

According to these figures the power of pressure increased by about equal stages until the thirteenth year, when, as in the case of the drawing-power, it suddenly made a very considerable rise.

[1] The measurements were taken with the dynamometer of Collin.

estimate.] The first efforts of the child to sit up in its cradle, bed, or on the mother's lap occur in the sixth month, very rarely as early as the fifth. Having gradually learned to sit up, it attempts to creep on the floor or hitch along, usually in the ninth month. It remains for weeks at this stage of locomotion, learning how to move the arms and legs rapidly and finding it an excellent preparatory training for walking. Some day it will raise itself from the floor with the aid of table or chair, fall back again, make another attempt, and at length succeed—the child stands alone. After a time, days or even weeks, letting go its hold and reaching out its arms for another point of support, it ventures to strive towards it with the legs, too, and *walks*. At first, owing to the imperfect co-ordination of the motions and the want of practice of the muscles, it is only with uncertain, staggering, and stumbling steps, but they become steadier from day to day. Thus, when it feels the strength to walk, the child learns, without instruction, without walking-chairs and such contrivances, in the simplest and best way. Healthy, well-nourished children begin to walk, on an average, from the eleventh to the thirteenth month. It is true that some children walk alone as early as the ninth month, but such instances are rare. If a child does not learn until after the fourteenth month, muscular weakness is to be suspected.

The use of the limbs of one side more than the other cannot be due to imitation and the influence of civilization, for one may observe in numbers of children not a year old, when imitation cannot enter into the question, a decided inclination to reach for things with one particular arm, usually the right one. Vierordt emphasizes this point.

Children of the rudest nations also give preference to the right arm. [The greater strength and initiative of the right arm depends on the earlier development of the left hemisphere of the brain, which corresponds to it.]

The practical lesson to be derived from this brief description of the physiological conditions is this:

A perfectly normal development of the bone and muscle system presupposes the influence of proper nourishment. An improper supply of lime salts will interfere with the development of the bone system, while an inadequate supply of proteine will prove detrimental to the muscular system.

We should be careful not to interfere with the physiological course of development, but to assist it all we can. Thus a child should never be made to sit, stand, or walk before its motions indicate that it is trying to do so of itself. It was a fact recognized by Galenus that premature experiments with the child in walking or standing frequently make its legs crooked, since the bone substance does not, for a long time, afford the requisite resistance. Leading-strings are unnecessary and may do harm by compressing the chest; and walking-chairs, however well constructed, are of no advantage. As soon as the child has learned to sit alone, let it be put upon a rug or a piece of matting, surrounded by a few pillows, and left to its own resources. In this way it not only learns to use its arms better, but also to move away from one spot, to creep, and so to employ the muscles of both upper and lower extremities. The child once having learned to stand alone, it is well to provide for it various points of support by placing it near tables or chairs, which it can reach after when it feels the impulse to move further. For this purpose the "fenced paths" (Gitterbahnen) are used in many public nurseries. It is, under all circumstances, harmful to lead a child by taking hold of one of its arms; it falters so often that distortions of the joints could scarcely be avoided.

The Position of the Child.—Great attention should be paid from the first to the position of the child. We know how yielding the substance of an infant's bones and liga-

ments is, and especially how flexible the spinal column is, and to how great an extent its later shape depends upon the position and weight. That is why care in this direction must be taken so early.

During the first six months, in which the infant has not the strength to raise itself, it should be kept in nearly a horizontal position. It should lie on the back, not on the side, with the head only a little higher than the body. If it lie on the side the spinal column is bent sideways each time, as may easily be observed, and this is strictly to be avoided. If the head is too high the ascending movements of the diaphragm are liable to be hampered. In carrying out these directions, the mistake must not be made of keeping the child in one position all the time. Hervieux, claims that to prolonged immobility of position, is due the excessive mortality in foundling asylums, because by its influence the circulation, respiration, and metabolism are all rendered more slow, and obstructions of the blood and effusions of blood in the higher organs are produced. This statement is exaggerated; yet there is a grain of truth in his words. The infant, as well as every one else, needs change of position once in a while. But conscientious care of a child necessitates this, for neither its body, clothing, or bed can be kept clean without frequently taking up the child and thus changing its position.

The flexibility of the spinal column and the feebleness of its ligaments must always be remembered when lifting a child. It must always be taken up with the greatest of care and never without supporting the head. The best way is to place one hand under the sacral bone and the other at the back of the head. Otherwise the head drops to one side and a stretching of the cervical portion of the spinal cord may be the consequence.

The nearly horizontal position described should be the one usually assumed. Even after the first six months the

infant should never be allowed to sit up straight on the arm long at a time, or be held habitually on the arm, for the spinal column each time assumes a lateral curve, as may be seen very plainly by looking at a naked infant sitting, or rather held, on its mother's arm. It rests with the gluteal parts on the forearm and leans with its left side against the breast of the mother, when the spinal column very distinctly curves at the chest portion with the convexity towards the mother. *Such a curve may very easily become permanent.* When the child is carried it should be held in both arms or on a pillow. In the former case, it should lie so that one arm of the mother or nurse takes hold of the lower part of the body, while the other arm supports the upper part.

[The danger of permanent curvature from the curve assumed by a child's back when supported upright on the mother's arm, must be exaggerated. For among the thousands of children so carried every day, it is certainly extremely rare to discover such a curvature. Scoliosis indeed rarely appears under ten years of age. The extreme elasticity of the child's spinal column allows it to quickly regain its position after temporary distortion, provided this be not too long continued.] As the child grows older, exercise of the muscles becomes of increasing importance. This leads to an increase of muscular mass, accompanied by a proportionate gain in muscular power. Then muscular exercise develops greater precision in muscular contraction, and increases voluntary control over muscles.

Moreover, muscular activity, and the chemical processes which precede and prepare it, constitute the great source of heat supply for the entire body. Non-nitrogenous substances of the food, and especially fat, are abundantly consumed during these processes; more carbonic acid and water are eliminated; more oxygen is absorbed.[1] Thus the activity

[1] According to Voit,[1] a person at rest and taking no food eliminates daily 716 grms. CO_2 and 821 grms. water, while the quantity eliminated by a person at work

[1] Voit in Hermann's "Handbuch der Physiologie," 1881, vi.

of the muscles increases that of the lungs, the respirations are increased fivefold,—and raises the beat of the heart 10 to 30 strokes a minute. If exertion be excessive or too prolonged, then the heart-beats become irregular, uneven, and feeble. Inadequate muscular exercise decreases the number of heart-beats, and predisposes to degeneration of the heart. The activity of the skin also is increased.

Finally, muscular work has a decided influence upon digestion. The appetite becomes keener, particularly for fat, and digestion proceeds more rapidly and more completely than with a lack of muscular exercise.

Muscular Fatigue and Recovery.[1]—When a muscle has worked continuously, or with great exertion, it grows tired. More energy of will is required to make it act, and, if its activity is persisted in, trembling ensues, the contractions grow unsteady, are interrupted by greater or less pauses of atony, and accompanied by an uncomfortable, disagreeable, or painful sensation. This fatigue is, for the most part, due to the presence of certain substances, which form during the work of the muscle, and are characterized as exhausting products of contraction. It is chiefly lactic acid which is supposed to play this part. It is formed in the active muscle; its presence exhausts the muscle, its neutralization or expulsion repairs it. But it is not alone the accumulation

and taking no food is 1187 grms. CO_2 and .1737 water, the former meanwhile taking up 761 O and the latter 1071 O. The increase in the waste of non-nitrogenous material is therefore unmistakable, while increase in the waste of nitrogen is not observable. The following figures of Smith [1] show what influence muscular work has upon the air drawn into the body through the lungs:

If the supply of air while lying down is	1
In a sitting posture it is	1.18
Standing	1.33
Walking	1.9–7
Riding	4.05
Swimming	4.33

[1] Compare Hermann, "Handbuch der Physiologie," 1879, I., 122 *seq.*; also Ranke, *Archiv für Anatomie und Physiologie*, 1863, p. 422; 1864, p. 320.

[1] Smith nach Roth und Lex, "Militärgesundheitspflege," iii., p. 176.

of the exhausting products which causes the condition just described. The withdrawal of oxygen likewise diminishes the excitability and strength of the muscle, and the addition of oxygen, as well as of arterial blood, has a recuperative effect.

It is evident that the suitable direction of muscular activity is of prime importance for hygiene. The muscular system must be harmoniously developed; it does not do to pick out certain groups of muscles and neglect others. Kotelmann noted, at the Hamburg gymnasia, that, as the students grew older, and their life more sedentary, the muscles of the legs lagged behind in their development.

Deficiency of exercise, in consonance with foregoing statements, retards muscular growth. Over-exertion greatly increases the waste of material and the accumulation of the chemical products of fatigue, and under all circumstances calls for considerable increase in the supply of nourishment and long pauses of rest. If both are wanting, the muscle is injured by the insufficient expulsion of the "fatigue products," and the whole economy suffers. Too early muscular exertion has the same influence as over-exertion. That which is wanted is reasonable exercise. In the period of infancy, as said above, it is best left to the instinct and will of the child itself, taking care that the movements of head, arms, or legs be not restricted by tight clothing, etc., assisting its motions as far as practicable, and removing all possibility of injury. [In other words, let the children play freely.]

In the further course of childhood, one of the best modes of muscular exercise is to engage in games of motion, the greatest advantage of which is the development of the physical powers. Riding on hobby-horses and rocking-horses, swinging, trundling the wheelbarrow, drawing the cart, running and playing with the top, rolling hoop, jumping rope, tossing and catching the ball, round games, and the other amusements of this happy period all exercise the

muscles, and not in a one-sided fashion, nor to a hurtful extent. When the brain has worked hard and continuously, regular recreation becomes an imperative necessity, which, according to experience, physical exercise is particularly adapted to meet. But the habitual bodily conditions of school-children also render exercise of the muscular system imperative. The child is obliged to sit still for hours at a time, and usually in an unfavorable position, thus laboring under the twofold disadvantage of muscular inactivity and its position. Private hygiene should therefore throw every thing into the scales to create an equilibrium, and balance the harmful effects as nearly as possible. To this end it insists upon much out-of-door exercise, both in field and wood, and prescribes for city school-children in particular, games, especially such as afford psychic and ethical training in addition to the muscular, as the game of ball. Of course we refer to the youth of both sexes; in fact, girls should engage quite as strenuously as boys in out-of-door romp and games.

Swimming possesses great hygienic value for children attending school. If correctly done, it calls into action all the muscles of the body, expands the chest powerfully, and stretches the spinal column out straight; hence, leaving the positive benefits of the bath out of account, it makes an excellent corrective of the evil effects of the school. Added to this, it increases to a great degree the child's courage and self-reliance. It is exceedingly good for the female sex, as has been very explicitly set forth by Dr. Elizabeth Hoggan.[1] Girls' muscles are weaker than those of boys; the influence of the school upon the position of the body is greater than in case of the boy, and, added to this, the chest of girls is confined more by the clothing. [This is an unnecessary evil.] For these reasons, swimming is most strongly recommended to girls. Children with disease of the lungs or heart should not be permitted to swim.

[1] Elizabeth Hoggan, *Sanitary Record*, x., p. 289.

Skating, also, when indulged in to a proper extent, has an excellent effect upon the health of both sexes. It brings about expansive movements of the chest, and exercises the muscles of the lower extremities, which during school life were doomed to so many hours of inactivity. Both reasons render it a valuable corrective of the unhealthful effects of the school. In addition, it is pre-eminently fitted to lend the youthful body a noble bearing and grace of movement.

Dancing, which early has a charm for children, may have the same influence. It should be practised in a sensible way—that is, with the object to be gained and the age of the child always in view. All of the advantages incident to games of motion and the physical exercises last named are possessed in an especially high degree by systematic gymnastics. Indeed, we may go so far as to assert that without it the full measure of physical and intellectual health cannot be attained. The ancient Greeks have been the only nation to recognize this in all its extent and to act upon it. For their noble bearing, the grace of their gait and all their motions, their working capacity, their endurance, their intellectual elasticity, their high-mindedness, and sublime courage,—for all these they were indebted to gymnastics, which they engaged in with so much faithfulness and right understanding.

From the preceding discussion of the influence of muscular work upon man, it is seen that systematic gymnastics has both temporary and lasting effects. The transitory effects are manifested by the rest of the organ hitherto active (a rest attendant upon every change of occupation), in this case, of the brain, and by the increased activity of the skin, lungs, heart, and digestive organs. The lasting effects are apparent in the better development of the muscles, in the attainment of a correct bearing, straight growth, enlargement of the thoracic cavity, and increase in the general power of resistance. Another important permanent

effect of systematic gymnastics is the development of the senses, especially sight and the muscular sense, also of hearing, increase of the power of observation and attention. In addition, systematic gymnastics tend to systematize the relations between the nervous and muscular systems, or, as one author well expresses it, clears the way between them, by causing the latter to work with rapidity and precision under the inspiration of the former. Finally, it is a permanent ethical gain to a human being to become accustomed to order, accuracy, obedience, to the endurance of fatigue and even pain. It is an advantage to learn to practise self-control, to exercise presence of mind, to acquire self-confidence and reliance on his own powers, to respect an honorable, open, and courageous spirit, and to despise a dishonorable, cowardly one. Thus gymnastics is an aid in the formation of a manly character, because it habituates those engaging in it to act according to definite moral principles; and it promotes a healthy ambition in noble contest, which is so necessary in life, and which directs all endeavor into proper channels. Physical exercise should therefore be entered upon not only for the sake of the health and power of resistance of the body, but also for the sake of the health of the mind; it should achieve the harmonious development of both.

Both boys and girls should participate in these exercises, and no one should be excluded but those whose general health is feeble, or who have a defect of the heart or an abdominal hernia. A commencement may be made at the end of the seventh year, but it is better not to undertake the more serious exercises before the completion of the ninth year, because the ligaments of the joints and the junctions of the epiphyses are not till then sufficiently firm and strong.

From this it appears that the exercises should always be suited to the age. They should also be adapted to the measure of strength and the sex. They should never be

entered upon when the body is in a condition in which the vascular system is already irritated or important organs are in functional activity—for instance, never directly after a meal. Change of exercises is necessary in order that all the muscles of the body shall have employment, and exercises that are heating and require much exertion should be dropped towards the end of the period devoted to practice.

The clothing during gymnastic exercise should correspond to the temperature, and at the same time be so light and loose that the most powerful expansions of the chest are not interfered with, or the motions in any way hampered. Girls should have an especial gymnastic costume. Loose drawers should be gathered together below the knees with an elastic band, a waist should be put on over the chemise, and over that a blouse loosely gathered at the waist and provided with wide sleeves.

In every school systematic exercises of the body should be a branch of instruction; for the duty of bringing all the capacities of body and mind to harmonious development devolves upon the school. I shall revert to this in the chapter on Gymnastics.

CHAPTER VIII.

CARE OF THE NERVOUS SYSTEM.

The nervous system of the new-born infant possesses, in comparison with the entire mass of the body, very great weight. The brain amounts to no less than 13–14 per cent. of the mass of the body (in the adult only 2.37 per cent.), the spinal cord .200 per cent. (in the adult .067 per cent.). The ganglia and nerve fibres of the new-born infant are no less strongly developed. The nervous system also grows so fast in the first year after birth that it gains in that time as much as in all the other years of life put together, and has attained at the end of the first year one half of its permanent weight. When the child reaches puberty, there is still lacking to the nervous system only one sixth of its weight in the adult.

We have the following data concerning the growth of the single parts: The brain, constituting in the new-born infant about one eighth of the weight of the body, is continually, though not uniformly, gaining all through the period of youth and up to about the thirtieth year. Sömmering[1] wrongly believed that its growth culminated as early as the third year. Hamilton and Tiedemann[2] removed this period to the seventh or eighth year, at least as far as size and volume are concerned. But Sims[2] maintains that the weight of the brain does not reach its maximum until between the fortieth and fiftieth years, and Weisbach[2]

[1] Sömmering, "Tabula Baseos Encephali Pueri Trium Annorum," p. 13.

[2] "Hirngewicht des Menschen," 1880, p. 46 *ff.*

between the twentieth and thirtieth years. Reid and Peacock (*Monthly Journal of Med. Sci.*, 1843 and 1846) found rapid growth taking place up to the seventh year, slow growth from the seventh to the twentieth years, and a standstill in weight between the twentieth and fiftieth years. According to Bischoff,[1] the relative weight of the brain increases in the first quarter of a year, for after the elapse of the first month the brain's weight is to the weight of the entire body as 1 : 7, after the elapse of the third as 1 : 5. The average relation throughout the first year is 1 : 6, in the second it descends to 1 : 14, in the third to 1 : 18. In the seventh year the relation is 1 : 12 for an unusually heavy brain, in the fourteenth it is 1 : 15–1 : 25. Hence a pause of slower growth apparently succeeds the first year's very great growth of the brain, and in the seventh year another stage of rapid brain growth arrives, followed by another and permanent period of slow growth.

After birth it is the cerebellum which grows most rapidly. In the new-born infant it constitutes but 6.7 per cent. of the whole brain, and in the child of two months it forms 9.1 per cent. of the whole brain. The anterior cerebral lobes grow very slightly at first, but more rapidly after the sixth year, their growth corresponding to the greater development of the frontal bone which then ensues. The spinal cord grows comparatively little, but it is known that its length constantly becomes shorter and shorter in relation to the spinal canal. The spinal cord of a new-born infant extends about 85 per cent. of the length of the canal, that of a child of two years only about 81 per cent., of a child of five years 76 per cent., of a child of nine years 65 per cent.[2]

The mass of a child's nervous system, particularly in the earliest years, is richer in water and blood, and is therefore

[1] "Hirngewicht des Menschen," 1880, p. 46 *ff.*

[2] Ravenel, "Die Maassverhältnisse der Wirbelsäule und des Rückenmarks des Menschen," 1879, p. 25.

softer than in the adult. This decidedly favors metabolism or tissue changes within the nervous system of a child. The difference between the gray and the white substance is inconsiderable.

The fissures and convolutions are clearly marked in the brain of a new-born infant. According to Sernow,[1] however, the secondary fissures are still in great part wanting; in the child six weeks old all are thought to be present.

The nervous system of a child, after the first weeks of life, is more irritable than that of an adult, and this is true of motor, sensory, and vaso-motor nerves. According to the experiments of Soltmann, the irritability of the motor nerves remains less only about six weeks, after which time it equals and soon exceeds that of the nerves of adults. This heightened irritability becomes apparent in the sensory nerves at about the twelfth week.[2] The well-known great reflex irritability of the child, which frequently manifests itself in convulsions produced by comparatively slight causes, is not so much a consequence of greater irritability of the peripheral nerves as of a functional peculiarity of the central nerve mass, together with a lack of inhibitory or controlling force exercised by one nerve centre over others.

Our knowledge of the functions of the central nervous organs is very fragmentary. From the experiments of Soltmann[2] on young animals it appears that in the latter the so-called centres of Hitzig, or motor centres, are not capable of functional activity. Irritation of these by an electric current was followed by no positive results until the tenth day, when the fore-paws of the animal could be made to move; and a few days later movements of the hind legs and of the face were produced. Irritation of the *corpus striatum* in dogs one week old had no effect; extirpation of the cerebral hemispheres with the *corpus striatum* produced

[1] Sernow, *Archiv für Anthropologie*, xi., 3, p. 294.

[2] Soltmann, *Jahrbuch für Kinderheilkunde*, ix., p. 106; xiv., p. 308.

no change in the movements. Thus the cerebrum manifests in the beginning of life very remarkable insensibility, which in man very soon gives place to sensitivity quite as remarkable. [With regard to the manifestations of psychical life, see farther on.]

The way in which the nervous system of the child is gradually accustomed to irritations and stimulated to activity, is of decided influence on its normal development. After the first few weeks it is certainly more excitable and more easily fatigued than that of the adult; the child accordingly, should be exposed to very gradual increase of irritations, should be kept from strong and prolonged excitement, and provided with frequent rest. The general nutrition powerfully influences the normal development of the nervous system. Children who have poor or insufficient nourishment, who are nursed by chlorotic, anæmic mothers or wet-nurses, frequently manifest at an early age an irritable constitution, so-called nervousness, and often suffer from convulsions of different kinds, as cramp of the glottis, or eclampsia. It is also well known that such nervousness very frequently results from too early indulgence in stimulants, coffee, tea, wine, beer, and tobacco.

CARE AND EDUCATION OF THE SENSES.

Physical and mental health both depend upon healthy senses. We do not derive our knowledge from within but from without. *Nihil est in animo, quod non erat in sensu.* It is from sense perceptions that our spiritual life emanates, and from which it constantly draws nourishment. The care and education of the senses are therefore of great hygienic importance, and all the more because only with great difficulty, if at all, can mistakes made in the care of the young be set right in later years.

Directly after birth, the senses of the child are but imperfectly developed, partly because the apparatuses for the

reception of impressions are still wholly unqualified for their office; partly because from want of practice they do not yet understand their functions; partly because of the failure of the brain to elaborate the impressions received from the senses. Weeks and months pass before the child reaches a degree of development of the senses which is comparable with the later condition. During this time the senses need especial protection from too precocious stimulation. Their education cannot be begun, until they plainly are ready to enter upon the performance of their functions.

THE SENSE OF SIGHT.

New-born infants are shy of the light, as every one knows who has had any thing to do with them. They open their eyes only in the twilight or very faint candle-light, and shut them again as soon as a bright light approaches. This shyness does not usually cease until towards the end of the third or in the middle of the fourth week.

The child probably does not really distinguish between light and dark in the very earliest period of life; the shutting of the eyes is purely reflex action; but towards the end of the first week such distinction begins, for we see children turn the head towards the bright side. In the fourth week they usually stare at a lighted candle held in front of them and follow it with the eyes when it is moved. The action of the eyes is still wholly uncontrolled, unsymmetrical; it sometimes happens that one turns to the right and one to the left, or that one stands still while the other is directed sideways. It is only by degrees and through practice that the child gains control over the action of the eyeballs, frequently not until towards the end of the third or fourth year, and never before the lapse of the first six months.

Cuignet's[1] observations agree with those of mine. On

[1] Cuignet, *Annales d'Oculistique*, lxvi.

the first day he found the child almost constantly asleep. On the second it opened the eyelids from time to time with symptoms of dislike of the light and turning one eye inwards. On the eighth the child was inclined to stare at bright objects, but it always looked cross-eyed when they were brought within one metre's distance from the eyes. On the twentieth day the child looked about without moving the head, but lost from sight objects held before it as soon as they were removed one to two metres. On the twenty-eighth the dislike of light ceased, on the sixtieth the mother was recognized. With five months the field of vision was complete and the head freely movable. In six months the child ceased to look cross-eyed.

The power of distinguishing colors comes much later, but in different children at very different times. If I may take the observations made on my own children for a basis, the child distinguishes no further than between black and white, dark and white, until it reaches its sixteenth or seventeenth month. Then it learns to distinguish red, then green, still later blue, and last of all yellow. It is very seldom indeed that the power of distinguishing all these colors exists before the beginning of the third year, and usually it is not found before the end of the third year; but very much depends upon practice.

The eye of the child is generally myopic or short-sighted at first, as Jäger[1] conclusively proves. Very soon, however, it becomes far-sighted, and this must be considered as the normal physiological condition of refraction in the child's eye, although far-sightedness very frequently passes over to emmetropia, and through this to shortsightedness once more.

To what is the initial myopia due? Woinow[2] thought the difference in refraction of the child's eye due to the difference in the intervals between the refracting surfaces.

[1] Jäger, "Einstellung des dioptr. Apparates," 1861.

[2] Woinow, Congrès period. intern. d'ophthalmologie, 4 Sess., 1872.

The essential point, however, seems to be the circumstance that the eye of the child has a shorter radius of curvature than that of the adult's. Mauthner,[1] v. Hasner,[2] and v. Reuss [3] have in a large number of cases most conclusively proved this greater curvature in the cornea. The last-named author found the convexity very prominent only in the first weeks of life. A considerable change occurs towards the middle of the first year, for from that time to the seventh year the length of the radius gradually increases. From this period to the twelfth year no change in the radius of curvature was perceptible, but in the thirteenth and fourteenth there was a decided growth. Between the fifteenth and twentieth years it reached the measure which passes as the mean for the normal eye.

That the hypermetropic eye of the child very easily becomes myopic is easily explicable from the circumstance that the child's eye yields comparatively more to intraocular pressure than that of the adult, and its axis may in consequence very easily become lengthened.

In consequence of the greater elasticity of its lens, the child's eye undoubtedly displays a much greater limit of accommodation than does the eye of an adult. According to Donders,[4] power of accommodation in children of ten years is about double that of a person thirty years old. In the latter the point of approximation to the eye is about five inches, and in the former 2.66 inches.

Other things being equal, children see more distinctly than adults, because the media of the child's eye are clearer and more intact. The smallest object visible to children of 10–15 years measures, according to Fellenberg, 0.0155 mm.; the smallest angle at which they are able to recognize pictures = 41 sec.

[1] Mauthner, "Vorlesungen über die opt. Fehler," 1876, p. 144 *ff.*

[2] v. Hasner, "Ueber die Grössenwerthe des Auges," 1878.

[3] v. Reuss, *Archiv f. Ophthalmologie*, 1881, ii., p. 27.

[4] Quoted from Vierordt, Physiologie des Kindes, p. 203.

As insisted upon in discussing the hygiene of the nursery, the eyes of the new-born infants should be protected from the irritation of too strong light, immediate exposure to which is in direct opposition to the physiology of sight. The child's natural shrinking from the light here indicates the only right way.

A word is needed on the prevention of *ophthalmia neonatorium* (the ophthalmia of the new-born) and its serious consequences. The imperative necessity for careful prophylactic measures against this disease is made evident by statistics, from which it is seen that no other eye disease more frequently results in blindness. Successful preventive treatment is possible only when taken up at the right time and with energetic means. Unfortunately, in an infinite number of cases midwives and nurses render this impossible. They are the ones who very frequently fail altogether to recognize the disease, do not call in timely assistance, or positively prevent its being called. Seidelmann reports twelve children, in whom twenty eyes became blind because the parents were kept from consulting a physician by the midwives. Every physician could mention similar instances from his own experience.

The prophylaxis of *ophthalmia neonatorum* may begin before the birth of the child, and there are conditions under which thus early measures should not be neglected. When it is known that a pregnant woman has leucorrhœa, especially the infectious gonorrhœal kind, the vagina should be syringed immediately before delivery with sol. bichloride mercury, 1 to 4,000. It is further recommended (Credé, Olshausen [1] and others) to wipe the eyes of every new-born child before it opens them with salicylized cotton, and soon, or even in the first bath, to wash them with a 2 per cent. solution of nitrate of silver or a 2 per cent. solution of

[1] Credé, *Archiv f. Gynäkologie*, xvii., 1 ; Olshausen, *Centralbl. f. Gynäkologie*, 1881, 2.

carbolic acid, in order to destroy any infectious germs that may have entered. In some instances excellent results have been achieved in this way. When the mother has not gonorrhœa, it would in private practice suffice to wash the eyes of the new-born infant with lukewarm water, repeating this two or three times daily during the first week. Abegg [1] has for years made successful use of this method in the Lying-in Hospital at Danzig. Of 2,266 children born there in ten years only 66 were affected with ophthalmia. Moreover, midwives and nurses are in this way obliged to keep the eyes under continual observation. To prevent the bad consequences of ophthalmia once contracted, the immediate aid of a physician is necessary. He should be summoned as soon as there is the least sign of inflammation of the eye, collection of mucus, more than usual shrinking from the light, etc. Midwives should be under legal compulsion to call in medical assistance, and should refrain from any interference on their own part. Every one who had any thing to do with washing the diseased child, for instance, midwife or nurse-maid, should be disinfected with the greatest of care. It is no less imperative to preserve from infection the eye which is still intact. Above all, the child must lie on the side of the diseased eye, and the hands must be properly secured to avoid rubbing.

The sense of sight needs exercise. The child's curiosity instinctively leads him to look at every thing he can, but it is in our power to minister to this natural desire by offering to the child objects which shall not only satisfy curiosity, not only awaken the pleasure of the sense, but which shall promote the training of the eye. Recognition of external form is before all things necessary to a perception of things, and is made much easier by the presentation of objects whose forms are at the same time well defined

[1] Abegg, *Archiv f. Gynäkologie*, 1881, xvii., p. 502.

and in strong contrast to one another. That which educates is the comparison of opposites. To such contrasts belong the sphere and the cube, as well as the cylinder, and in these the eye of the child in association with the sense of touch has most suitable objects for practice. Later comes the box of building blocks, whose contents make clear the conceptions of perpendicular, horizontal, the right angle, etc.

The exercise of the sense of color is of next importance. This cannot begin, as is evident from foregoing remarks, in the first year, but may be taken up towards the end of the second or in the beginning of the third. It should be pursued with all diligence and in all seriousness, since the chief condition for distinguishing things is the recognition of their color. But how few persons there are who are able to perceive different shades of color other than the conspicuous ones—and all from want of practice! Training of the sense of color is, moreover, a powerful aid to the training of the sense of the beautiful.

Begin with the presentation of two primary colors which through their contrast are most easily impressed, and let them be seen on the playthings, balls, cubes, cylinders, etc. Then proceed to present the other colors. Delhez[1] describes a suitable apparatus. The gradations of red, yellow, blue, orange, violet, green, are applied to little wooden tablets 1 cm. wide and 3 cm. long, and placed in order. The child's practice now consists in hearing the colors named, naming them himself, in laying the mixed tablets in the proper order under guidance, and finally in himself making other color combinations. The apparatus of Brücke[1] (Hartinger) may serve to develop the sense of color still further. In this apparatus a circle is divided into twelve parts, and contains in the succession of the spectrum the three principal colors—red, yellow, and blue—with nine intermediate

[1] Official Report of the Vienna Exhibition, 1873, 1.

colors. Each of these twelve rays is again divided into twelve grades of color. Towards the centre of the disk, the primary color grows darker until it becomes black, and towards the edge it grows lighter until it becomes white, so that the table really contains all colors used in the arts and industries. The order is such that the colors opposite one another are always complementary. A series of color tables, each of which bears two complementary colors on a black background, and another series, each table of which has three harmonious colors on a black background, serve to represent still more plainly the effect of the harmonious colors. These tables form the basis of the theory of colors, in accordance with which the children are to learn to name and compare the colors, and to arrange them after the laws of color harmony. The color tablets[1] recently described by Magnus fulfil the same purpose. There are also tops with complementary colors, which in spinning show the mixed colors, and balls with two complementary or three harmonious colors.

Many games are of use in training the eye to make correct measurements. First there are active games, particularly those with the sphere and the ball. Even the simple game of toss and catch is valuable, likewise grace-hoops, the bow and arrow, and others. Further, there are stick-laying, the cutting out of geometrical figures, games with tablets of such figures, and finally drawing.

The observation of nature in field, meadow, and wood, and in the starry heavens, always remains the best and most salutary exercise of the sense of sight, particularly in the latter years of youth. It trains in a rare degree the sense of form and color, gives sharpness of sight and correct eye measurement, makes it necessary to adjust the eye for distance, and is therefore the best corrective for injury to the eye in school, while at the same time it promotes the sense

[1] Magnus, "Die methodische Erziehung des Farbensinnes," 1879.

of beauty. The hunter, the farmer, the mountaineer, all illustrate to what a high degree the eye can be trained by practice, and they should therefore serve as a pattern in the training of the eye.

THE SENSE OF HEARING.

All new-born children are for hours, and sometimes for days, what may be called deaf. This is owing to a peculiarity of the middle ear, which, as was recognized by Fabricius *ab Aquapendente*, directly after birth contains no air. The subepithelial layer of the mucous membrane of the drum cavities is very much swollen, and fills up the space which the auricular bones need for their excursions [Tröltsch,[1] Wendt,[2] and Wreden[3]]. The subsidence of this swelling, although prepared for in interuterine life, does not follow until some time after birth, after air has entered the Eustachian tubes, in consequence of the movements of swallowing, and from there has reached the middle ear. As a rule it is accomplished with the lapse of the first day, but is sometimes delayed for several days.

The first signs of an irritation of the nerves of hearing, a starting of the body or of the arms after a sudden noise, may be perceived on the second or third day; but they are still very feeble in comparison with the strength of the sound. Nevertheless the sense of hearing develops very soon. Frequently the child turns its head towards the side whence the sound comes as early as the sixth or eighth week, and it almost always does this by the twelfth or thirteenth week. In the third month jingling toys afford him unmistakable pleasure, likewise musical tones. Very loud sounds, as well as shrill or harsh sounds, are disagreeable to him, and easily frighten the child or make it cry. In the further

[1] v. Tröltsch, Verhandlung der phys. med. Gesellschaft zu Würzburg, ix., 1855.
[2] Wendt, *Archiv f. Heilkunde*, xiv., 97.
[3] Wreden, *Monatsschrift f. Ohrenheilkunde*, 1868, 7.

course of childhood the hearing is comparatively keen. The boy of ten years, when he is paying attention, hears decidedly more plainly than an adult.

The organ of hearing, like that of sight, needs protection, particularly in the first year. As soon as the short stage of the initial deafness is past, the infant reacts upon loud sounds much more violently than the adult, because his reflex excitability is greater. The fright of a child is very frequently connected with trembling succeeding it, with long-continued feeling of fear, with sleeplessness, and even with convulsive twitchings. Those nervously disposed may through a sudden fright have severe eclampsiæ, or cramp of the glottis. We should therefore protect the child as much as possible from all violent and sudden sounds.

The ear should receive particular attention in diseases which are so often followed by complete or partial deafness, as scarlet-fever, cerebro spinal meningitis, typhoid fever, so that in case the affliction appears corresponding remedies may be applied immediately. [To these predisposing diseases may be added pharyngo-nasal catarrh, and earache.]

Corporal punishment should never be administered in the region of the ear.

The first exercise of the sense of hearing is listening to the simple rhythmical refrains of the mother's slumber songs and nursery lays. They entertain and soothe the child at the same time. Later comes the child's own song, the singing games with their pretty rhymes, so sympathetic to the child that they actually comprise one of his needs; then still later methodical practice in singing and music with their powerful influence upon the forming emotional nature and temperament.

Finally sharpening of the hearing and training it to recognize the finer shades and colors of sound are very valuable. This is done, as we shall see, by many games of children, particularly the blindfold games.

An excellent means to this end is again the observation of nature, particularly of the notes or calls of our birds, in whose voice the careful listener discovers and recognizes so much which, superficially heard, fails to reach the perception. Very pleasant memories of my youth are associated with daily walks in the woods during which I was initiated into this study of the voices of animals by my extremely well versed teacher. To these walks I am indebted for a multitude of inspirations and also for an unmistakable sharpening of my sense of hearing.

CARE OF THE SENSE OF TOUCH.

From the effects of a warm bath, which awakens a decided feeling of comfort in the new-born child, we see that the latter has a sensation for temperature. It also seems to feel pressure and touch, since, after a sufficient exertion of either, reflex actions are observable. It is scarcely possible, however, that at birth the skin possesses any localizing sense. It is developed by experience, and is therefore stronger in older children. Camerer[1] found that of his two daughters whose sense of touch he examined, the one eight years of age had a sense finer by one tenth than the one of six years. The investigations of the same physician also show that the child's localizing sense in different parts of the body differs widely from that of the adult. The child is at a decided advantage as regards the localizing sense of the finger tips, the most important region, and is superior as far as the elbow joint, acromion, and upper arm are concerned.

The exercise of the sense of touch may develop it to a high degree of perception. To what extent this is possible we see in blind persons, who acquire a wonderfully delicate sense of touch, so that a coin is recognized with certainty simply by feeling of it with the fingers. The child's earli-

[1] Compare Vierordt.

est exercise of this sense takes place without any assistance from us when it handles toys or other objects. Of course real training cannot be undertaken before the sixth or seventh year, but should on no account be neglected at that time. A good contrivance for the practice of the sense of touch in the fingers may consist of strips of different kinds of cloth which are numbered according to their thickness or softness, and are to be arranged by the child in their right succession. After he has had frequent practice in this way, the order may be changed, and the child required to guess the numbers of the single strips with the eyes closed. This, as I have often convinced myself, trains the touch remarkably, and is of infinite value to every one, particularly to certain trades and professions; for instance, to many artisans, manufacturers, merchants, and to the physician. A similar exercise may very suitably be had with different natural objects, as leaves of flowers, bushes, and trees. I should give this the preference by all means, for the development of the sense of beauty is promoted at the same time.

Many active games of childhood furnish good exercise to the sense of pressure and the muscular sense, particularly ball, quoits, and nine-pins. But for systematic practice, small wooden cubes, externally just alike, may be used, the weight of which may be changed at will by loading them with larger or smaller quantities of lead.

TASTE AND SMELL.

The sense of taste clearly exists from the first, for the new-born child is affected very differently by sweet, sour, or bitter liquids. Kussmaul[1] ascertained this years ago by means of interesting experiments. After sugar the children's lips made very active sucking movements; after quinine or vinic acid, or a solution of salt, they made all

[1] Kussmaul, "Ueber des Seelenleben des neugebornen Menschen," 1859.

sorts of grimaces which betrayed decided discomfort. Preyer[1] found that new-born animals also unfailingly distinguish between the most different kinds of substances—camphor, thymol, rock candy. Accordingly the statement is well grounded that the sense of taste exists from the first moment of life. Training of the taste is scarcely necessary.

It is probable that the sense of smell is clearly developed in the new-born infant. Preyer is of opinion that it does not have sensations of smell in the first hours of life, because it does not draw up any air into the nose, but that it very soon distinguishes impressions of smell. The latter is true, for it is beyond all doubt that children can smell milk very well in the first days. In general their sense of smell remains remarkably obtuse, even late in childhood.

Training of the sense of smell has not yet been attempted, but it well might be.

If the training of the senses is engaged in with due consideration of the age and perceptive power of the child, it contributes great gain to the intellectual life. It furnishes a quantity of positive points of support and comparison which are always being sought with avidity by the child; it sharpens its faculties of observation and combination, and accustoms him early to the necessity for clear contemplation and thorough investigation. Thus it creates a solid foundation of intellectual health, and is at the same time of eminent practical importance.

[1] Preyer, Pyschogenesis, in *Deutsche Rundschau*, 1880, p. 211.

CHAPTER IX.

INTELLECTUAL HEALTH.

THE SOUL'S ACTIVITY.[1]

The new-born child has been correctly called a spinal-marrow individual. Its functions as observed are vegetative, not psychic, derived from the activity of the brain. True there exist some general sensations, those of comfort and discomfort, which must without doubt be looked upon as the first stirrings of the soul; but they are still unconscious and shadowy. The senses also are still wrapt in almost complete slumber, and what they feel is not yet elaborated. The motions of the new-born child are not voluntary, but, as already said, automatic and reflex, and such as are also seen in children born without a brain.

Little by little the transformation to an individual with cerebral functions takes place. The motions of the child leave behind them feelings at first shadowy, but which by repetition become more distinct; and in like manner the sense impressions give birth to notions faint at first but growing all the time clearer and clearer. These associate themselves with those feelings, and they together form the beginning of psychic life. All sense perceptions and feelings are at first entirely irrelative. Gradually they are brought into connection with causal factors, and we see the child becoming acquainted with the external world. This is rec-

[1] Compare Vierordt, Physiologie des Kindes, in Gerhardt's "Handbuch der Kinderkrankheiten," 1877, i., p. 207 *ff.* Wundt, "Grundzüge der phys. Psychologie," 1874.

ognition, the awakening of consciousness, with which the stupid expression characteristic of the first three months disappears.

Repetition of the same notions and feelings produces the first beginnings of *memory*, and comparison of two or more notions, *judgment*. Whether these two faculties of the soul are first the achievement of the taste and the region of that sense, as Preyer[1] believes, is scarcely demonstrable; it is quite as possible that they are simultaneously or earlier awakened by feelings of pressure and temperature.

The repetition of notions and sensations associated with the satisfaction of the organism, producing a pleasant feeling and gradually leaving this feeling behind them, lead to desire, wishing, longing, and effort; and effort very soon to motions which incorporate those conceptions. From the last arises the *will*. In the earliest period of life there is not the least evidence of a will; the hungry child cries, but only because of a general shadowy feeling. Later he cries from a conscious impulsion, from the longing after a something which has become known to it,—that is, it cries intentionally or with a *will*. At first it reaches towards an object without reflection, without any definite idea; then contact with the object awakens certain sensations, and the sight of it certain notions which produce a feeling of satisfaction. This last keeps on, is heightened by seeing the same object again, and leads to a desire which finds an outlet in the now voluntary because conscious movement of grasping.

This transition of unconscious to conscious motions is by no means sudden as many suppose; indeed it takes place so gradually that in a certain period of the child's life the most careful observer can with difficulty distinguish whether a motion was voluntary or not. Under all circumstances the child's will is exceedingly weak or, better, uncontrollable. It possesses no reserve of contrasting ideas which might

[1] Preyer, Psychogenesis, in *Deutsche Rundschau*, 1880, vol. xxiii., p. 198 *ff.*

influence the interpretation of the will by a motion. Therefore the child is by nature eager and obstinate. It is the task of education to influence or modify this being by supplying it with definite ideas.

The child is born with the instinct to take nourishment, for this does not originate with the sight of the mother's breast or the notion of food, but with the dim feeling of hunger which leads to desire. Other instinctive desires are developed in the further course of childhood, such as those for activity and for company, and the imitative instinct. These are all physiological and should not be suppressed.

The affections are developed from the feelings, particularly from those of desire, satisfaction, and dissatisfaction and thus do not exist from the first. The first smiling, which may be observed as early as four weeks after birth, is not an expression of joy, but joy is indicative by the smile on the face of a child three months old when it recognizes its mother as she approaches. [Much earlier we should say.] Signs of affection, fear, anger, do not appear until later, generally within the first year, manifesting themselves with increased strength in the second, as soon as the child's relations to the outer world have multiplied. It is worthy of remark that they usually appear very quickly and upon slight cause, but disappear just as quickly, that they shift easily and are rarely or never connected with the deep agitations of the somatic or psychic ego, as so often observed in the emotions of grown persons.

A temperament, that is, a definite attitude of the mental condition with relation to the origin of the affections, does not exist in the earliest period of life, since the affections themselves are wanting in the beginning, but it assuredly begins to form within the first year. In children in the second year the phlegmatic temperament is, as a rule, easily distinguishable from the choleric and sanguine. It is true

that compared with the adult every child may be called sanguine, but it may nevertheless be intrinsically choleric or phlegmatic.

We have just seen that the affections of the mind develop from the feelings and conceptions; the same is also true of speech, which is only the expression of those ideas as manifest in certain muscular movements, just as mimicry is the expression of the affections. The first speech of the child is unconscious, not understood, and not associated with conceptions; it is only the expression of a dim general sensation, and manifests itself solely in a differentiated crying. Whoever has studied this understands this first speech, and can tell from it whether the child is hungry or cold or in pain, and can tell where the pain is, whether in the head, chest, or lower part of the body.

Later, when the feelings have become conscious and ideas of a definite kind are added, the speech is also more distinct. The child begins to utter sounds in which consonants (m, n, b, p, d) and vowels are heard, while the eloquent language of mimicry and gesture make an appearance. The first beginnings of real talking are not observable until conceptions are forming, towards the end of the first or early in the second year. The sounds then made are mostly imitations of men or animals, but are not infrequently without analogy to other sounds, and are of the child's own creation, being invariably designations of definite, concrete apprehensions of the senses, as the mother, father, the dog, the cat, bitter, sweet, hot, etc. The sounds then pass into words, which at first often represent several notions. After this the child places two words together, joins an adjective to the noun, further an infinitive, and so learns to form sentences. This is, as a rule, in the commencement of the third year, seldom earlier. The use of the word *I* begins still later, usually in the second half of the third year.

This is in brief the origin and early development of the soul's activities, of feeling and idea, of memory, judgment, the will, the affections, and speech, all from sense perceptions.

In the further course of childhood all these functions gain in strength, keeping pace with time. The sum of the ideas grows by virtue of the increasing quantity of objects with which the child comes in contact, and its eagerness for knowledge, which manifests itself in numberless questions. The growth in intensity of the impressions and images is none the less due to the exercise and perfecting of the senses. In this way grows memory also, and then through exercise attains itself continually greater perfection. The ideas among themselves are continually becoming more closely associated and undergoing a more durable comparison with their cause; in short, elaboration is going on better, the understanding and power of judgment are growing. The latter is indeed less evident than the increase in the treasure of ideas and the growth of the memory. The child in the first year is chiefly receptive; later it begins to ask for reasons, to analyze, make combinations, and becomes then an independent thinker and productive.

Stress has repeatedly been laid upon the fact that all early feelings of the child are called forth by sensible objects. Abstract notions remain long a closed book to it, an important point to remember in educating a young child. They are derived from the concrete very gradually, as the notion of what is "good" from images brought up by a certain act and a reward following, the notion of "bad" from images brought up by a certain act and a punishment following it. Similarly, ideas of the unworthy, dishonorable, cowardly, etc., are developed. Until a certain sum of these abstract conceptions has won a place in the general supply of ideas, there can be no question of a distinct will or character. The period at which this is the case differs strongly with individualities and the manner of bringing

up a child, but it is by no means rare that a strong will shows itself in the fifth or sixth year.

The child has a cheerful and easy disposition. Even strongly dejecting impressions affect it slightly and but for a little while. If we find it depressed or cross for any length of time, it is almost always due to present or approaching illness. The frame of mind is often despondent, flighty, or capricious at about the time of puberty.

The end aimed at in the intellectual training of the human being, should be the most perfect, harmonious development possible of the spiritual capacities with which it is endowed.

The education of the powers of observation and judgment and of the memory are involved; also, the securing to the intellect the greatest possible freshness, promptitude, and productivity, the lending to the heart contentment and a healthy strength, the promoting of benevolent inclinations, the awakening of sympathy with what is noble, the continual striving towards the end that the will shall be strong, but under the mastery of its possessor. All the faculties and powers, therefore, and not merely some of them, should be developed, and fully developed. Then only will the child progress into an individual of strong character, energetic, mentally fresh and capable of resistance, independent in thought and action. Such a one is demanded by the family, society, and the state. Persons who are unable to make correct observations and form correct judgments, who are too excitable or insufficient in their emotions, who are indolent in thinking, wavering in their decisions, who have never learned to govern their affections and will, to endure disappointments and make renunciations, are unequal to the storms of life and the claims of their fellow-creatures.

Thus, in the intellectual training, which, together with the organization of the brain at birth, essentially

constitutes the individuality of the mental being, take care above all for systematic development of the power of observation and the reasoning faculty, for calm, clear judgment and deliberation; and combat superficiality in viewing and comparing, and undue predominance of the imagination. This plan will protect against numberless disappointments which are liable to endanger intellectual health. Take care also to preserve the childlike content of mind; fight against vacuity, but also against too ready mobility and sensitivity of the emotional nature; accustom the child to govern both the affections and the will, to obey that of its superiors, and renounce the vain ego; and teach it to pursue in open, honorable endeavor good aims with courage and resoluteness. Then the intellectual health will be preserved and improved.

For the attainment of the full measure of the latter, continual consideration must be had for the physiological course of the mental development, which, like that of the body, is not accomplished by leaps and jumps, but step by step. First the child learns to view things, next to observe, then to make comparisons and form a judgment; at first it imbibes, afterward it creates. Therefore let there be no premature education not corresponding to the physiological development, no over-haste, but slow, gradual progression.

It is imperative to carefully consider the peculiarities of the mental nature of children. This nature is pliant, but tender and sensitive; cannot endure permanent compulsion, nor treatment which is rough, mortifying, or too stern. It is injured, also, by great compliance; it is seldom that a "mother's boy" becomes a fresh, energetic man. The delicacy of the mental nature forbids much or continuous exertion uninterrupted by sufficient recreation; it also forbids all strong excitement, particularly of a kind which frightens a child, produces a state of uneasiness, or strains the imagination.

It is likewise necessary to carefully observe the individuality, the particular endowments and capacities of the single child. These are so widely different that the intellectual education, no less than the physical, should never be conducted according to one set plan, but should individualize in each case.

Finally, it must never be forgotten that a healthy body and healthy senses are the fundamental conditions of mental health. Mental training should, therefore, never be so conducted that the body may suffer from it, but should strive to turn bodily training to account for the intellect.

These are the principles which should guide us. Failure to observe them results in imperfect development; and there is moreover danger of serious derangements of health, and grave pathological conditions. I attribute to such failure nervous excitability, this so prevalent vulnerability of the nervous system, which, itself very frequently the consequence of wrong training, easily becomes in turn the cause of other diseases; and then intellectual invalidism; lack of strength or desire to think and to do; want of moral strength, of firm will; even complete mental bankruptcy, insanity in its various forms;—conditions which are so often imputable to the faulty method of bringing up children.

The first mental culture of the child falls exclusively to the family, particularly to the mother; and happy the child who receives from the latter protecting and fostering care. The senses must first be cultivated, for out of the sense perceptions are evolved the thoughts and emotions. It is, therefore, by no means an indifferent matter what the child sees, what it feels, what it hears. The field of training should not be extended until the mental affections, whether of desire, longing, or of aversion, fear, anger, have clearly and strongly appeared. To hold to the right method with regard to these is a most difficult but at the

same time a most requiting task, the fulfilment of which exerts great influence over the child's physical and spiritual health. The mental affections, when overwrought, as they inevitably become under wrong management, give later abundant cause for physical and psychical disturbances of the greatest variety. Only she will strike the right road who descends into the child's world of thought and feeling, who remembers that stormy passions are characteristic of children, that they appear upon slight occasion, and that in the earliest period the child has no comprehension whatever of didactic instruction in morals. Therefore it is only the excess of emotion which is to be combated, not through premature satisfaction or removal of the cause, not through compliance, but by means of a serious look, chastisement, and if possible by awakening notions which themselves have a corrective influence and convince the child of the impropriety of its emotional excess.—as for instance, in the case of *fear*.

The awakening natural instincts next demand attention; above all, the desire for activity. This must be given due consideration, fostered and not suppressed, because, as already said, it is quite physiological. The child wishes to be busy; therefore opportunity for action must be given, not withheld. Activity gives the child the pleasure of the senses, begets in him a feeling of satisfaction and gladness; and besides it creates an abundance of new ideas and experiences; but it must be directed and watched over, because it is very easily perverted through bad example and dim, inexplicable stirrings from within. No less careful attention must be given the social and imitative impulses. The satisfaction of both of these is a need of the child, gives him pleasure and joy, supplies him with new incentives in great number, and so becomes a powerful lever in the perfecting of spiritual development. It is possible, likewise, for these two impulses to take the child

astray, where serious dangers await the mental health, but they are not on this account to be suppressed, only led into a right direction. Even the child's propensity to learn, which manifests itself so powerfully, needs guidance, if only to protect it from all excessive excitation. This necessary direction of the natural instincts is accomplished in play and by means of the game. Any other intellectual occupation than that chosen by the child itself and engaged in during play, should not under any circumstances be entered upon in the first six years. Experience taught years ago that the attempts at premature training of the faculties of the understanding end, in by far the greater number of cases, in failure. It is, indeed, often observed that children make good progress for a time; but then they come, sooner or later, to a standstill, a mental lameness intervenes, which unfortunately only too frequently proves permanent, and results in a decided lagging behind the average. It is but rarely that children who have been thus prematurely urged on fulfil the hopes at first set upon them by parents and teachers. More than this, they frequently suffer from bodily derangements of a serious character, becoming anæmic, chlorotic, nervous, subject to much headache, falling ill with St. Vitus' dance, etc. We shall therefore persist in our requirement that the child shall be withheld from all scientific instruction, even of the purely elementary kind, until the completion of its sixth year. Indeed, if we might proceed according to hygienic principles alone, we should let the whole of the seventh year go by without such instruction, for in this year renewed and rapid growth of the brain takes place, which calls for cautious treatment. Perhaps the many sad experiences of the present age will lead us finally to settle upon that as suitable which hygiene would on grounds of physiological development prescribe. It is an every-day experience that a large majority of the children who do not enter

into scientific instruction until their eighth year, within a comparatively short time overtake children of their own age who were placed under instruction earlier, and sometimes soon outstretch them, reaching the goal mentally fresher than they. Nothing can argue more convincingly than this for the correctness of the hygienic standpoint. I believe that the number of mentally indolent school children, now so exceedingly great, would be greatly decreased if children were not withdrawn from play until a whole year later than is now the case.

In the period before attendance at school the child should be living a strong, healthy, emotional life, and acquiring a firm will power. It is not too early to look to this, as appears from preceding paragraphs; and it is of immense gain to the mental health to make advance in this direction at the right time. To practise the child in the control of its will and the endurance of pain, to foster benevolent inclinations, noble impulses and actions, to contend against the ignoble, to impress it with love of truth and candor,—all of this may be begun during the time which we call the period of play. The details belong to pedagogics, not to hygiene.

From the moment in which the child is sent to school, school and family undertake together the mental culture of the child, and with it the responsibility not only of preserving but of improving its mental health. But children must be led on to do mental work in the right way: disciplinary education which must be had in view; the storing up of knowledge is of lesser importance. The latter, as Finkelnburg[1] is quite right in saying, can always be acquired, while the former, if neglected at the proper time, can never be made up for. But the school should do still more; it should not alone exercise the powers of the under-

[1] Finkelnburg, Ueber den Schutz der geistigen Gesundheit. *Niederrheinisches Correspondenzblatt f. öffentliche Gesundheit.*, 1879, p. 77 *ff.*

standing and the memory and increase the memory, but it also should form the character and the better nature, supply the child with a fund of ethical and religious notions to serve as support and weapon in all situations of life, awaken aspirations towards the beautiful, noble, ideal, and engender healthy ambition, orderliness, and conscientiousness.

The family should not relax care of the mental health of the child, even after consigning it to the school. The parents' assistance lies more especially in the province of ethics, and they should give particular attention to the cultivation of the heart and character, which in this period need unusual care. At this juncture, when the child is suddenly called upon to forego the unrestraint hitherto enjoyed and to make mental effort, there is its natural cheerfulness to preserve, upon which mental elasticity so largely depends; further, there is the wildness and roughness so easily engendered in intercourse with companions of its own age to oppose, the young will to strengthen and at the same time teach the mastery of, serious errors to resist. It will now more frequently be necessary for the child to make sacrifices and bear disappointment, to put down the vain ego. All of this will be the chief end of the care which the family should direct to the child's health of mind. It goes without saying that it should also contribute to the development of the power of judgment and calm, clear thinking, and to the growth of the child's love of order, so important throughout life.

But school and family should never forget that mind culture without proper physical culture can never yield the result desired. If there is to be full unfolding of the mental capacities, there must be corresponding physical education. Only the harmonious development of both ensures the attainment of the real end; while neglect of the bodily improvement gives much reason to fear that close mental application may occasion grave bodily dis-

orders. This is why strict regulation of the proportions of mental, physical culture and recreation is so imperatively necessary. Hygienists and teachers should make an exact estimate of the measure required, and then school and family should respect the standard set up authoritatively.

THE CHILD'S PLAY.

How highly important a factor play is in the preservation and improvement of health, in the freshness and alertness of both body and mind, has been emphasized again and again. A continual and pleasurable incentive to the senses, it exercises the body and forms the mind. It supplies the child with an abundance of new images, new notions, sharpens its power of observation and combination, and gives it ample opportunity for invention. Besides, play exercises a powerful influence over the formation of the heart and character, a fact which was fully appreciated by the ancients. The best effect of games is that they bring contentment, cheerfulness, and recreation. Every one needs to be inspired with gladness if he is to preserve mental freshness, and most of all the child with its active, sanguine temperament. This is why it seeks play, why play is to the child one of the necessaries of life. Withhold the child from play, and it will develop one-sidedly, will receive no harmonious training of the spiritual faculties, and even under the most favorable circumstances will fail to attain the maximum of his productive powers. Children much occupied in mental application, must have recreation or they will grow weak; and the best recreation is not idleness but play. A child suffers *ennui* if it has nothing to do after school hours, and seeks play instinctively as a necessity. Thus for school children, above all, opportunity for play should be secured as systematically as the means of study. Thus only can the normal elasticity of childhood in body and mind be preserved.

From the hygienic standpoint it is by no means a matter of indifference what and how the child plays. We demand of playthings that they shall in no way endanger the health. This they may do:

1. Through their size. Small objects, like peas, beans, buttons, coins, marbles, beads, little stones, are very frequently put into nose and ears by young children, and should therefore be kept from them.

2. Through their form. Pointed, sharp, and sharp-cornered objects like needles, knives, etc., may cause injuries of a serious nature in the hands of young children.

3. Through the material of which they are made. If easily broken, like glass, or thin porcelain, or if they are very inflammable, they often produce injuries; many objects of metal may be poisonous, as paint-boxes, little printing-presses with lead type, lead soldiers.

4. Through the external coating or envelope, as in many colored playthings. These may be poisonous when injurious colors have been used.

Dangerous games should sometimes be forbidden, but in certain amusements, as skating, coasting, etc., some risk must be incurred for the sake of the advantage gained. Finally it must not be forgotten that play, with its undeniable influence over the child's whole feeling and thinking, over the development of heart and character, may also under some circumstances be attended by dangers to the spiritual health. Roughness and heartlessness, vanity, arbitrariness, and haughtiness, faults which are of such vast importance to the spiritual life in later years, have often been stimulated and nourished by the games of childhood.

We divide children's games, with the exception of infants' play, according to the principal activity developed in them, and distinguish between:[1]

[1] I follow essentially Schettler's division in his "Spiele zur Uebung und Erholung des Körpers," 1878.

1. Games of motion.
2. Games of rest.

(a) Of games of motion, the most extensive are those with the ball, which must be regarded as the best of all playthings, because it is harmless, indestructible, and may be easily moved.

The child in the first year plays catch with it, and accompanies the motion with a rhythmic song. It satisfies thus its need of exercise for muscles and for the organs of speech, and at the same time practises the eye in the valuation of distances, directions, etc.

In the further course of childhood the ball and bat take the place of throw and catch, and the game of ball proper, which, as we know, is of ancient origin and was cultivated with great zest by Greek tribes. It necessitates, firstly, very healthful muscular exercise, engenders rapidity and skill of movement. Besides, it trains the senses, particularly sight and the muscular sense, for distances must be measured, direction of flight and amount of force to be applied must be estimated. This game educates youth to closer attention and presence of mind, teaches each to be at his post at the right time, shows that punctuality and attention are rewarded, awakens a healthful ambition, and accustoms to discipline, subordination to the majority and to established principles. All of this is of high importance to physical and spiritual health, and it is to be regretted that with us Germans the game of ball, especially in cities, is very much neglected, and that young girls especially do not take part in it more. This is partly due to the increasing scarcity of playgrounds, particularly in and near cities, but partly also to modern training, which is unfortunately only too apt to discard what is childlike as early as possible.

(b) The game of bowls, played either with the rolling ball or with the ball hung up by a string. Marbles, mumblety-peg, Italian bowling (French *jeu de boules*), Scotch,

mail, English croquet, billiards, and *Kugelschwingen* are all included. They exercise the eye and the muscular sense, but many, such as Italian bowling and croquet, have an educating effect similar to the game of ball. Billiards is particularly worthy of recommendation for growing youth. It is highly entertaining, through the variety of situations, practises the eye and the muscular feeling to a rare degree gives constant occasion for attention, observation, and combination, besides lending to the body great mobility, suppleness, and dexterity.

(c) Nine-pins. This game is played either in bowling-alleys or on boards or tables. In the first case, it calls for strong movements of the body, particularly of arms and legs, and thus affords good gymnastic exercise; all practise the eye and muscular sense.

(d) Games with disks. To these belong the simple game of quoits *(palet)*, the foot game of disks, and curling. They all require adroitness, alacrity, mobility, sharpen the eye and the attention.

(e) Ring and top. The first is played by setting a ring suspended overhead in motion, in order to catch it on a hook fixed at a certain distance. It requires estimate of distance, direction, and force to be applied, and thus is excellent for sight and muscular sense. The physical exercise involved, is comparatively small. The game is suitable for children from the fifth or sixth year on, and is an excellent after-dinner amusement. The spinning of tops practises the muscular sense.

(f) Running, leaping, and marching games. These include the hoop, jumping rope, hobby-horse, racing, bar-leaping, tag, limping and hopping, the "hunt," soldier games, etc. They are principally games of bodily exercise, which strengthen and practise the muscles of the legs; the greater number of them also sharpen the attention and the observation. This is particularly true of the hunting and

soldier games, which exercise the body in running and leaping, but also force the senses and the mind to constant watchfulness. Both give the children opportunity of displaying not only physical adroitness but also various mental capacities, quickness of thought, resoluteness, open courage, and at the same time give full play to free activity.

(g) The snow games, that is, sliding on sleds and snowballing. They serve to inure the body to the cold of winter, to exercise the muscles of the arm and the muscular sense.

(h) The blindfold games. Blind-man's-buff, breaking pottery, hide-and-seek, the hunt in the dark, etc. They sharpen the senses of touch and hearing, because the one who is blindfolded is compelled to exert these senses more than usual. The night games—for instance, the hunt in the dark—serve, besides, the very important purpose of accustoming children to the dark and overcoming fear of the dark.

Games of rest sharpen particularly observation by means of the senses, memory, the power of combination, attention, and also awaken the sense of form and of beauty. Some of them encourage the child's creative powers. They may be divided as follows[1]:

(a) Those which essentially serve to train and sharpen the senses; to these belong the games of early youth with the colored ball, the glass or metallic harmonicum, the accordion, the trumpet.

(b) Those which promote the child's activity and creativeness; these include the use of building blocks, tools, the cutting out of paper figures, folding and weaving, stringing beads; also moulding in clay, and play with dolls' houses, kitchens, theatre.

(c) Those which sharpen the attention; to these belong games of imitation, many puzzles and forfeit games, the spelling hour, the game of command, in which each

[1] Schettler also makes six subdivisions, but in a little different way.

child called upon has to carry out a certain order as quickly as possible.

(d) Those which strengthen the memory, as historical, arithmetical, geographical games, and Campe's journey game.

(e) Those which sharpen the powers of combination and reflection. These are the games of question and answer, conundrums, "Damenspiel," the mill, wolf and lamb, chess, lead soldiers, and some children's war games made in imitation of the game of war for adults.

(f) Those which improve the sense of form and beauty; puncturing and cutting out geometrical figures, the bracket-saw, parquetry or tablet-laying.

Many of these games of motion and rest are accompanied with song, and there are some in which the song is the chief thing, as "Ring a round a rosy," *der bunte Kranz*, London Bridge, etc. All of these singing games serve, first of all, to preserve and strengthen a feeling of gladness, to satisfy the social impulse, and also to exercise hearing and memory.

The different kinds of games must of course be adapted to the age of the child, and some are only for boys, or better for them, while others are better for girls. The natural feeling of the child almost always hits upon the most suitable game; nevertheless the teacher should keep a watchful eye over the choice. It belongs to pedagogies to give directions.

PROTECTION OF THE HEALTH AT THE APPROACH OF PUBERTY.

With the approach of puberty certain somatic changes are accomplished which we have already discussed in their bearing upon our subject, as more rapid gain in weight, enlargement of the chest periphery and the vital capacity of the lungs, increase of the mass and strength of the muscles; at the same time psychic modifications also manifest themselves, which all the more deserve our full

attention, because they may cause a predisposition to serious diseases. Mysterious emotions, imperfectly or not at all understood by the child, appear, disturb the equilibrium of the ego, and modify the spiritual condition. This is exhibited very often in absence of mind, moodiness, irritability, restlessness. Under certain influences, particularly morbid heredity, wrong bringing up, wrong treatment of the emotional nature, over-exertion of the mind, and also from the effects of onanism, a great fright, etc., real mental disease may develop at this period of life. This betrays itself in different ways, sometimes as primary insanity, sometimes as melancholic and even moral aberration. Melancholy is often connected with impulsive acts, with hallucinations directed to suicide, or to destruction of property (incendiarism). Epileptic and hysterical derangement, somnambulism, are also nervous diseases to which the period of puberty is especially exposed.[1]

The child in early years is only very slightly exposed to such serious dangers. We may hope to avert these dangers, by care in securing the conditions requisite for the physical changes incident to puberty, by providing the child with proper nourishment, clothing, and exercise; and by keeping every thing which could give rise to mental trouble far removed. If nervous or mental disturbance threaten, little reading should be allowed, and all severe mental application should be forbidden. Possible onanism should be carefully guarded against, and great caution should be observed in administering humiliating or rigorous punishment. Children are irritable at this age and often take such things to heart, more seriously than is intended. They are then easily misled into perverse actions. This attention to the psychic condition at the period of approaching puberty should be given to boys as well as girls, but more

[1] Compare Griesinger, "Pathologie und Therapie der psych. Krankheiten," 1876, p. 203; and v. Krafft-Ebing, "Lehrbuch der Psychiatrie," 1880, i.

particularly to the latter, because they more frequently become ill at this time.

PUNISHMENT AND REWARD OF THE CHILD.

Hygiene has but one requirement to make with regard to the punishment of children, namely, that it never be of a nature to impair the health. Chastisement should never be administered on or near parts of the body where any of the higher organs are situated; never on the head, especially not on the ear, temple, or back of the head; never on the nape of the neck or on the abdomen. Children should never be chastised to excess nor with means which might produce injuries. From the switch and the stick this is probably not to be feared. If a child is being punished by confinement, it should be under constant observation, and be suitably occupied. Great caution must be exercised in withholding food as a means of punishment. A child cannot endure insufficient nourishment, and if it be frequently deprived of its meals, it is easily rendered dyspeptic, and harm may very easily result. [It is a barbarous custom, borrowed from a fancied analogy to certain points of training animals.] I should consider it much more to the purpose to refuse to allow the child to partake of one or more of its favorite dishes. Children should not be punished by making them afraid, (making them stay alone in the dark). The nervous system of a great number of children reacts upon this kind of discipline in a way little to be desired. The result may be constant fear, which nothing is able to soften, restless sleep, great irritability, depression of spirits, and even permanent mental injury.

Finally, too rigorous and excessive punishment, particularly when it is connected with humiliation or wounding to the self-respect, may be really dangerous to the mental health. As Griesinger[1] remarks, with emphasis, such pro-

[1] Griesinger, "Pathol. u. Ther. der psych. Krankheiten," 1876, p. 161.

cedure checks the development of the natural benevolent inclinations of the child, and chokes the more tender impulses and emotions. It occasions a painful break between the individual and the outer world, which often upon slight cause becomes a pathological nervous condition.

Of course rewards should never be such that they injure the health of children. I lay stress upon this, remembering the habit of giving eatables to children, which is a means of reward very frequently employed. Sweets constitute one of the greatest pleasures of children, and now *die Philanthropisten* have gone to the extent of encouraging this appetite for use in training children, giving fruit, cakes, etc., for good behavior, good answers at school, etc. It is not my office to discuss the pedagogical error of such a procedure, but I do emphasize the fact that, for reasons given on page 102, it is detrimental to health and should on that account be energetically opposed.

WRONG HABITS WHICH ARE HARMFUL TO MENTAL HEALTH.

There are wrong habits and vices of children which exert or may exert great influence over their physical and spiritual well-being, and which must therefore find notice. Among them are:

1. Uncleanliness with regard to the excreta.
2. Sucking.
3. Masturbation or onanism.

Uncleanliness with regard to the excreta of intestines and bladder is not to be avoided in the first months of life; the disadvantages can only be obviated through removal of the diapers with all possible frequency, through keeping the body clean, and through ventilation. After the elapse of the first five months habituation may do wonders, if only seriously and consistently followed up. The child must be trained early to cleanliness, must be taken up often and given opportunity with as much regularity as possible. If

this is not done, that which the child originally could not help will soon become a wrong habit and can only be cured at the cost of great anxiety and trouble to the ones responsible for its welfare.

Wetting the bed, a habit which sometimes lasts even over puberty, is in many cases nothing but a bad habit contracted in earliest childhood, although it is undoubtedly oftenest occasioned by a pathological condition of the urinary muscles or by want of sensibility in the bladder to the irritation of the collected urine. The consequences are very disagreeable; the bed has a strong smell which fills the whole room, frequently excoriations and boils appear upon the nates, and the spirits of the child suffer also. It becomes shy, bashful, and even melancholy and nervous.

To prevent this habit it is necessary above all to awaken a love of cleanliness in earliest childhood, to see that excretions from the bladder take place regularly and always before going to sleep. General strengthening of the organism by means of suitable nourishment, the frequent bathing in not very warm water, [say rather cold water,] the avoidance of drinking just before bedtime, and of lying on the back, are all of favorable means. The attempt may be made to prevent the supine position by tying a cloth around the body with the knot on the back. Chastisement and threats of still more severe punishment are of no avail.

The habit of sucking is one which is remarkably widespread among children; it is found in at least sixteen per cent. of them. Lindner distinguishes between simple sucking and sucking with combination. The former consists in sucking the fingers, back of the hand, arms, great toes, lips, tongue, also foreign bodies, such as the rubber of a nursing bottle, apron, piece of the night-gown, etc. The latter consists in using the fingers while sucking to rub some part of the body, as the ear, the sexual parts, in order to excite a pleasurable sensation. Some children excessively addicted

to sucking cause themselves pain, or accompany the procedure with actions which are disagreeable or distasteful to other children.

Even young infants have the habit of sucking. Most frequently it develops in the second year, is often retained for years, and by no means rarely until puberty. The favorite time for practising it is before going to sleep, upon awakening, after the bath. Those who have the habit to excess practise it almost their whole waking time and are in ill humor when disturbed.

The ill effects are, according to Lindner, of two kinds. First, the mouth acquires after a while a peculiar shape through misshapen lips, which are often accompanied by deformity of the lower jaw and irregular formation of the teeth.[1] Besides, a tendency to onanism frequently arises from sucking, as well as *scolioses* (through the constant use of one arm), and imperfect mental development.

This evil habit, once it has gained ground, is very hard to destroy. On this account it is necessary, as soon as the first signs appear, to keep the children under restraint, to observe them before they go to sleep, when they awaken, after the bath, and make sucking an impossibility. If the passion has already taken root, kindness is much more effectual than severity. Children may be influenced by making the act appear ridiculous to them, or by promising something in case the habit is relinquished. It is seldom of any use to put on bitter substances, or to tie or wrap up the place which the child sucks. It occurs rather frequently that the child cures itself, especially of sucking the finger.

Masturbation or onanism in children results in greater injury to the health. It has been observed in infants of seven or eight months. Fleischmann described two cases of this kind a few years ago.[2] In children two or three years

[1] Lindner, *Journal für Kinderheilkunde*, xiv., 1, pp. 68 *ff.*

[2] Fleischmann, *Wiener medicinische Presse*, 1879. Compare Jacobi, "On Masturbation and Hysteria in Young Children," 1876.

old it is by no means of rare occurrence, but it is found most frequently in children over eight years old, girls as well as boys. The outward symptoms, when masturbation has been practised some time, are pallor, change of color, dark rings under the eyes, languor, moroseness, loss of desire to play, irritability, susceptibility to fright, headache, blank staring, dyspepsia, constipation. Local symptoms are redness, swelling of the foreskin or the labia and *introitus vaginæ*, and *leucorrhœa*.

The cause is almost always the bad example of other children, servant-girls, nurse-maids, men-servants. A week ago I was asked for advice with regard to two children, one a boy of three years, the other a girl of four, who had been led on to onanism by their own aunt, a girl of seventeen to eighteen years. But children also learn to practise masturbation without any example. It may be occasioned by lying in warm beds, sitting with the legs crossed, reading obscene books, the presence of *Oxyuris vermicularis*, (thread worms,) inflammation of the prepuce, small size of the prepuce, the habit of sucking. There are also certain gymnastic exercises, on the horizontal bar, for instance, which by rubbing against the genital organs give rise to masturbation.

The consequences differ with the child's constitution, the degree to which the vice is persisted in, and the period when it was begun. Pallor, thinness, diminution of muscular strength, and palpitation of the heart are symptoms which appear almost to a certainty; but the effects are sometimes more serious, such as nervous disorders, convulsions of an epileptic nature, real epilepsy, partial lameness, and paralysis. Henoch[1] mentions a case in which a boy seven years old contracted *ataxia* and *enuresis* through onanism. He had been addicted to the vice since his fifth year, having been influenced to it by a relative who slept with him. It

[1] Henoch, "Vorlesungen über Kinderkrankheiten," 1881, p. 195.

is certain that the memory, power of judgment, and the entire mental elasticity may suffer through onanism; neither can it be denied that it may give rise to mental derangement, particularly when there is an hereditary tendency in that direction, and during the transition to puberty. A whole list of such cases is noted in the annals of psychiatry.[1] According to von Krafft-Ebing, onanism increases nervous affections when it occurs in a person of neuropathic constitution, and is then liable to cause mental derangement. When it occurs in individuals not under the pall of heredity, it easily leads to neuropathy, which in turn may at the first opportunity break into insanity. Serious consequences are nevertheless rare in comparison with the numbers of those addicted to the vice in question.

The great prevalence of masturbation necessitates the observation of children from an early age on, in order that the habit may be checked at the outset wherever it exists. If it is deep-rooted, eradication is difficult. The latter is most easily accomplished when the children are under the age of six or eight years. Energetic punishment when the deed is fresh is usually effectual. It is quite otherwise with older children. It is, above all, very hard to convict or to surprise them, and by the time that parent or teacher finally gains certain knowledge that the habit exists, it has usually acquired insuperable power over its victim. Reprimands and threats are notoriously almost always useless. Only the sharpest and most consistent surveillance, as well as the severest punishment, can do any good. Besides, it is necessary to give careful attention to all minutiæ which in one way or another could give rise to masturbation. The child must be kept out of the way of evil companionship and bad reading, should sleep on a hard bed and get up immediately

[1] *Nasse's Zeitschrift*, 1835, i., 205; Flemming, *Psych.*, p. 141; *Nasse's Zeitschrift*, vi., p. 369; von Krafft-Ebing, *Irrenfreund*, 1878, 9, 10; *idem*, *Laehr's Zeitschrift*, 31, p. 425; *idem*, "Lehrbuch der Psychiatrie," 1880, i., 141, 184.

upon awaking, should not sit with the legs crossed, etc. If either narrowness or inflammation of the prepuce or the presence of pin-worms is the cause, measures must be taken accordingly. Richet[1] has made use of the operation for phimosis in cases of incurable onanism in which there was no phimosis, simply to inspire fear under threat of repetition. It has been proposed to bind the arms, to place a plaster-of-Paris cast over the sexual parts. Many kinds of mechanical appliances are in use, but their availableness is questionable.

[1] Richet, *Gazette des hôpitaux*, 1879, 30.

APPENDIX TO CHAPTER V.

THE SLEEP OF THE CHILD.

The character of sleep still remains unfathomed. Some consider it to be a consequence of over-fatigue of the central nervous system caused by the accumulation of fatiguing products; others think it a consequence of cerebral anæmia, or of a suspension of stimuli. Still another opinion is that it is produced by the activity of a particular inhibitory centre having its seat in the cerebrum (Schrank). However that may be, we know that during sleep the disintegration of albumen proceeds at almost the same rate as during the performance of work, that (24 per cent.) less of oxygen is used up, and that less carbonic acid is eliminated, because the muscles are at rest and the stimuli to the activity of the nerves cease. Through sleep non-nitrogenous substances are stored up, especially fat; moreover, through sleep the organism appropriates a new store of oxygen, which fits it for new work.[1]

As is evident from the foregoing, the child needs sleep more than the adult. Its metabolism, or tissue change, particularly of just the non-nitrogenous substances, is more rapid and its waste of oxygen greater. Perhaps the latter is the essential circumstance, the one which causes the long, sound sleep of children, since in new-born infants, at least, there can scarcely be questions of an accumulation of fatigue products arising from muscular exertion. Children's sleep certainly is long and sound.

The new-born infant sleeps continuously as long as it is not drinking. It does not remain awake fifteen minutes at a time until the third or fourth week; in the seventh or eighth it stays awake half an hour, in the fifth month an hour and longer without interruption; but from the tenth to the twelfth month it still sleeps more than it wakes. During the second and third years the time of sleep diminishes still more, lasting usually ten to twelve hours in the night and two to three in the daytime. Later the need of sleep in the daytime seems to cease, and attempts to compel sleep are usually futile; but all through childhood and boyhood there is a demand for abundant sleep. If na-

[1] Hermann's "Handbuch der Physiologie," vi., i., p. 204. (Voit.)

ture is allowed to take its own course with strong, healthy children, who have sufficient opportunity for frolic, and not over a permissible amount of mental exertion, it will be found that

at the age of 7 years 10-10½ hours of sleep,
" " " " 10 " 9½-10 " " "
" " " " 12 " 9 " " "
" " " " 14 " 8½ " " "

are required.

Nature's full measure of sleep should by all means be taken by children who are anæmic or chlorotic, or who are constitutionally not very strong, since just such children show very soon and conspicuously symptoms of weakness and excitability when robbed of sleep. On the other hand, it is quite clear that too much sleep may also prove harmful. The health of the organism is dependent upon a proper division of the life-time into hours devoted to activity and hours given to rest. The organs require rest from time to time, but also suitable activity and exercise; otherwise they lose in working capacity. Too long-continued sleep also furthers the formation of fat, because it is chiefly during rest that fat is stored up. Another great cause of harm is that, as a rule, the longer sleep is continued the more the air becomes contaminated with offensive substances. Thus it is necessary to guard against harming the child with either too much or too little. The data given above will serve as a guide. They nearly coincide with those once given by Friedländer.[1] He drew up the following table of hours of sleep, rest, and employment:

	Sleep.	Rest.	Bodily exercises and play.	Employment (mental).
At the age of 7 years,	9-10 hours,	4 hours,	10 hours	1 hour
" " " " 8 "	9 "	4 "	9 "	2 hours.
" " " " 9 "	9 "	4 "	8 "	3 "
" " " " 10 "	8-9 "	4 "	8 "	4 "
" " " " 11 "	8 "	4 "	7 "	5 "
" " " " 12 "	8 "	4 "	6 "	6 "
" " " " 13 "	8 "	4 "	5 "	7 "
" " " " 14 "	7 "	4 "	5 "	8 "

It is a mistake to send children to bed with a full stomach. An infant has no difficulty in digesting nourishment during sleep because its food is liquid and easily assimilated, but with older children, whose food is solid, the case is different. If they take their supper just before

[1] *Cfr.* Simon: "Traité d' hygiène de la jeunesse," Metz, 1826, p. 238.

bedtime their rest is disturbed, doubtlessly because the excess of nervous irritation is drawn off from the digestive tract to the central organs. Sleep is then unsound, is often interrupted or molested by bad dreams. The evening meal should be taken at least three quarters of an hour before bed-time, should consist of light food for children, should not be too abundant nor contain too much solids.

Infants over four months old should not sleep with their clothes on. It hinders the respiration and circulation, and heats the body. The use of regular sleeping apparel suited to the age of the child is recommended. Children who kick off the blankets in their sleep should wear a comfortable waist to which a pair of loose drawers is attached. Boys of more than seven years need nothing but a night-shirt.

It is decidedly injurious to produce artificial sleep in children. This is known to be done when infants are restless and do not go to sleep as soon as desired. The means used are rocking, opiates, and alcoholic mixtures. We have already seen that violent rocking is bad and uneven rocking still worse. That for infants opiates are extremely dangerous, that they should be made use of only in case of illness, and then with the greatest of caution and in the smallest quantities, are to all physicians long familiar facts. Many never prescribe opiates for children under six months old unless for *Trismus* and *tetanus*, or other diseases of like serious prognosis, in which all hinges on the restoration of a state of quiet. But if the administering of opiates in early childhood is notoriously so hazardous, it must be wholly and most severely reprobated, and prosecuted when practised merely to soothe restless but otherwise healthy infants, whether a real preparation of opium is used, or poppy juice, or a decoction of poppies. The sad data of English statistics must serve as a warning to all ; they show an unprecedented number of deaths among little children from convulsions, which, as has been said, have been quite generally traced to the evil habit of giving soothing syrup and brandy to little children. I need not again emphasize the fact that brandy, with all alcoholic mixtures, should be scrupulously avoided for little children on account of its influence upon the nerve centres. [This does not exclude its medicinal use in certain diarrhœas and other exhausting diseases.]

If infants are so restless that they do not go to sleep or awaken very soon, the cause of this abnormal condition must be investigated, and steps taken according to each individual case. Sometimes the clothes are too tight, or a pin pricks, or the bed is too warm, or the room ; sometimes the child was mentally excited before going to bed, or it had colic pains or wind, or was put to bed with its hunger only partially satisfied. Once the cause is removed, undisturbed sleep will return.

Sleeplessness in children between the ages of two and six is rarely found; when it does occur and there is no real illness, either something is wrong with the sleeping-room (too light) or bed (too warm), or the nourishment is not properly administered, or the wakefulness is due to erethism of the nerves produced by strong excitement of the senses or of the imagination, as by hearing ghost-stories or other fear-inspiring tales, by dread of severe punishment, and sometimes by the presence of worms. Of course it is only by removal of the cause that such a condition can be successfully combated.

If children attending school are troubled with sleeplessness, it is almost always occasioned by a similar erethism of the nerves, the causes of which may usually be traced directly or indirectly to the school. This condition, part of the so-called "school fever," greatly affects the constitution of children suffering from it, and is something very much to be deplored. This agrypnotic state in children of the above age may also be produced by excessive reading, particularly late at night, by neglect of the muscular system, and by masturbation.

RELATION OF THE WEIGHTS AND MEASURES OF THE BRITISH PHARMACOPŒIA TO THE DECIMAL SYSTEM.

1 pound = 453.5925 grammes.
1 ounce = 28.3495 "
1 grain = .0648 gramme.

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1 gallon = 4.543487 litres.
1 pint = .567936 litre.
1 fluid ounce = .028396 "
1 " drachm = .003549 "
1 minim = .000059 "

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1 milligramme = .015432 grain.
1 centigramme = .15432 "
1 decigramme = 1.5432 grains.
1 gramme = 15.432 "
1 kilogramme = 15432.348 "
1 kilo = 2 pounds, 3 ounces, 119.8 grains.

LIST OF AUTHORS.

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